Elements of Surgical Diagnosis

Pearce Gould

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ELEMENTS OF SURGICAL DIAGNOSIS

Elements of Surgical Diagnosis

BY

SIR ALFRED PEARCE GOULD

Sixth Edition, revised by

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PREFACE TO THE SIXTH EDITION

With the striking exception of the diagnostic use of X-rays, the progress of Surgery since this book was first published has done little to provide short cuts to the diagnosis of surgical affections, and accuracy and confidence in diagnosis are still to be attained only by methodical and complete examination. Thus it comes about that almost forty years after its first appearance, the general scheme of the book remains unchanged.

The alterations in the present edition consist in a re-arrangement of the chapters in two sections of the volume, to give a more natural sequence; the introduction of certain recently recognized surgical conditions; the revision in points of detail of the book generally; and the insertion of fifteen new radiographic illustrations.

As instances of diseases included for the first time, I may mention Labyrinthitis in connexion with Otitis Media, Cæcal Stasis, and Perthes' Disease of the Hip. In the chapters on Intestinal Obstruction and the Surgical Dyspepsias a good deal of revision was required to bring them up to date, but some alterations will be found in every section of the book.

For the ready help afforded me by several of my colleagues at the Middlesex Hospital I am very grateful, and in particular to Mr. F. J. Cleminson, F.R.C.S., who has carefully revised the chapters on Surgical Diseases of the Ear, Nose and Throat. To Dr. Douglas Webster and Mr. Magnus Redding, F.R.C.S., I am indebted for the new radiograms, and to Dr. Knox and Sir John Thomson-Walker for the further use of X-ray plates which appeared in the fifth edition.

It is a pleasure to put on record once more my appreciation of the continued help and unfailing courtesy of the publishers.

E. P. G.

16, *Queen Anne Street, W.*1.
August, 1923.

PREFACE TO THE FIRST EDITION

My chief object in writing this book has been to state, so far as lies in my power, those principles of diagnosis which apply in all cases and under all circumstances. The application of these principles to the diseases and injuries of various regions has been given as fully as possible.

I have thought it best to separate the diagnosis of injuries from that of diseases. While aware that this course is not in strict accordance with the ways of Nature, it has yet seemed to possess the advantage of greater simplicity, and I trust that it will not interfere with any usefulness the book might otherwise have.

I have great pleasure in acknowledging the able assistance I have received from my friend Dr. Angel Money, who has kindly revised the proof-sheets and made many valuable suggestions.

In view of the importance and difficulty of the subject, it is with great diffidence that I venture to submit this manual to students and practitioners of surgery.

A. PEARCE GOULD.

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ELEMENTS OF SURGICAL DIAGNOSIS

CHAPTER I

METHOD IN DIAGNOSIS

In this manual an attempt is made to study the process of diagnosis, and thereby to put the reader in possession of knowledge which will enable him to determine the nature of a patient's ailment. The **process of diagnosis** rests, firstly, upon accurate observation of the facts of the case, and, secondly, upon their correct interpretation. The facts should, as far as possible, be observed by the surgeon himself, and accuracy in observation must be his first aim. There are three particular points to be remembered in the appreciation of facts.

The first of these is the recognition of the **significance of each separate observation.** For instance, the sign of fluctuation does not necessarily signify the presence of pus, nor retraction of the nipple the existence of a mammary scirrhus tumour. Fluctuation merely indicates the presence of fluid under certain special physical conditions, but it tells nothing whatever of the origin and nature of the fluid. A retracted nipple signifies a disproportion in the length of the galactophorous ducts, but it tells nothing of the cause of this disproportion. It is all-important that students should strenuously cultivate the habit of looking behind symptoms and signs to their physical or physiological significance, and not regard them as so many ultimate facts: they should ask themselves why a certain combination of symptoms necessitates or renders highly probable a particular diagnosis.

The second point to remember is that **data vary very widely in value**; care and experience are needed to form a right estimate of their value. Failure in this respect is one of the common causes of mistaken diagnosis. Positive data are of more value than negative; objective signs of disease are of more value than subjective; all data vary in value with the care and competence of the observer. But we cannot afford to reject altogether negative and subjective data, or refuse to accept observations made by unskilled observers.

The third point to bear in mind is that **certain facts are of conclusive value in diagnosis**, and one of the aims of clinical and pathological study is to add to the number of such. Thus, the evidence afforded by X-rays in fracture or dislocation is of this conclusive kind. Again, the detection of the *Spironema pallidum* (*Spirochæta pallida*) in the discharge from a sore on the genitals establishes the nature of the sore, and renders the clinical characters of the lesion of no diagnostic importance. Many of these conclusive facts are only obtained by the help of special laboratory or other assistance, which may not in all cases be available; it is of the utmost importance, therefore, that the student should develop his powers of purely clinical diagnosis, using these special aids as checks upon his own observations, and not as excuses for slipshod or incomplete examination.

Of late years surgical treatment has become very largely operative, and in the course of an operation the nature of a case is often cleared up much more completely than was possible beforehand. Although clinical diagnosis must often come short of the demonstration afforded by an operation, this is no justification for neglect of the clinical means of diagnosis. An accurate diagnosis will often obviate a useless operation, and nothing facilitates an operation more than an exact knowledge of the conditions to be dealt with.

A diagnosis, to be complete, should include the recognition of, first, the anatomical features of the local lesion; then, its physiological or pathological characteristics; and lastly, the constitutional change either leading to or resulting from the local lesion. For example, take the case of an enlarged gland in the groin. The first step in the diagnosis is to determine that it is an enlarged gland, and not a hernia, a varix, or a fatty tumour, etc. This must be followed by an inquiry into the nature and cause of the enlargement, whether inflammatory or neoplastic; if inflammatory, the nature and source of the infection, and if neoplastic, whether primary or secondary. Finally, it must be ascertained how far the general system is implicated, whether primarily or secondarily, as by fever, exhaustion, anæmia, etc.

Apart from the clinical data afforded by the examination of the patient, the progress of his affection, and the effect of treatment, valuable help in the diagnosis is derived from a consideration of the *family history*, *personal history*, and *history of the cause* or *first onset*.

Family history.—In some instances we seem justified in assigning to heredity great importance, in others its influence is wholly unrecognized, and between these two extremes we meet with all possible degrees of difference.

Of those affections of surgical importance in the parents which are justly believed to influence disease in their offspring, the most important is **syphilis.** There is no doubt that syphilis is inherited, but it is no less certain that all the children of syphilitic parents are not themselves the subjects of syphilis. In general, the liability to inheritance is greater, the shorter the interval between the infection of the parents and the birth of the children. To ascertain that the patient is the subject of inherited syphilis is of the utmost importance; for not only may it at once determine diagnosis, but it will exert a distinct influence upon treatment, and in very many instances form the sole guide to the management of the case.

Hæmophilia is also an important hereditary affection, and, where this exists in a family, evidence of it is usually obtained, as the repeated and often fatal hæmorrhages are facts which strongly impress the laity. It must be remembered that inquiry is to be mainly directed to the male members of the family, as it affects them only, although it is transmitted through the females. The faulty metabolism manifested in **gout** is often inherited, as is also the tendency to **congenital deformities. Acholuric jaundice** is another disease, now surgical in character, which is definitely inherited.

Tuberculosis, whether of lungs, bones, or glands, is not inherited, but a predisposition to the disease certainly is. Evidence of this predisposition to tubercle in a family is usually readily obtained, for phthisis, diseases of bones and joints, lupus, and lymphatic glandular enlargements are too obvious, too chronic, and too serious in their results to be overlooked or forgotten.

It is a common belief among the laity that a similar predisposition to cancer may be inherited, but real evidence for this is wanting, and a family history never influences the diagnosis of the nature of a tumour.

Personal history.—The points in the personal history of the patient which assist in the diagnosis are: 1, *Race*, e.g. the greater frequency of diabetes and hæmophilia among the Jews. 2, *Age:* many conditions can only occur when the skeleton is immature, e.g. separation of epiphyses, while others, such as rodent ulcer, only after the period of full maturity has arrived. 3, *Sex:* apart from the diseases of the distinctive sexual organs, there are certain diseases which are more common in one sex than in the other, e.g. hæmophilia in the male, movable kidney in the female. 4, *Civil state*, whether single, married, or widowed; if married, whether nulliparous or parous. 5, *Habits*, particularly as to the consumption of alcohol and tobacco, and lack or excess of exercise. 6, *Occupation:* for example, working in phosphorus, mercury, lead, paraffin, tar, the handling of hides or horses, exposure to wet and cold or to severe strain, kneeling, constant standing, mining, and contact with soot. 7, *Residence abroad*, by exposing the patient to special infections, e.g. schistosomiasis (bilharziosis) in Egypt, hydatid disease in Australia, filariasis in tropical Africa. 8, *Previous diseases:* the common affections liable to be followed by sequelæ of surgical importance are venereal diseases, enteric, dysentery, scarlet fever, measles, and phthisis.

History of the affection.—Having obtained an account of the supposed origin of the affection, note carefully its exact course, and the order, mode, and time of development of any changes in it, together with the effects of any treatment that may have been adopted. And first comes the **influence of injury.** A large class of cases, such as wounds, fractures, sprains, are commonly described as "injuries." But, among diseases, injury plays an important part by admitting infective organisms to the tissues, and also by converting tissues into a suitable nidus for the growth of organisms, and so localizing infective diseases. There is reason to think that injury plays some part as an exciting cause of the growth of tumours. An injury is often the means of attracting the patient's attention to a pre-existing morbid state. A blow alleged to be the exciting cause of a tumour of the breast may merely have led a patient to make an examination of the part and detect a lump which, not being painful or prominent, had previously escaped observation. The only way of avoiding this error is to ascertain as accurately as possible the succession of events and the time-relation of the injury and any signs or symptoms of disease.

The **mode of progress** of the disease may be an important factor in diagnosis, for while any disease may steadily advance, only certain forms are capable of spontaneous recession, e.g. a bruise or an inflamed gland; or of an intermittent or remittent course, for instance appendicitis, hernia, and movable kidney. The mere duration of an affection may exclude some forms of disease, as for instance malignant growths and acute inflammation.

The **sequence of symptoms** is sometimes of importance, as, for example, where renal colic is followed by signs of vesical calculus, or where the apparent reduction of a hernia is attended with no relief to, but rather an increase in, the severity of the signs of strangulation of the bowel. The **relative intensity** of various symptoms may aid in the diagnosis; thus, the absence of pain may exclude acute inflammation, or the frequency and amount of vesical hæmorrhage may clearly connect any other urinary symptoms with the presence of a tumour in the bladder. Lastly, the time-relation of any **constitutional state,** such as anæmia, wasting, jaundice, or cachexia, may indicate whether it is the cause or the result of some local morbid state.

In reference to the **results of treatment,** special significance is to be attached to the influence of general tonic treatment, of rest, of counter-irritation, of surgical operations, and of the usual antisyphilitic remedies.

The **general method** of diagnosis varies with different surgeons: some prefer first to obtain a complete history of the case, and then to make their examination of the lesions presented; while others first make their examination, and then investigate the history of the case. For beginners, however, the former and more laborious plan is the better, lest important points be overlooked; and it is only safe to practise the more direct method when clinical experience has developed the instinct which enables a surgeon to elicit just those points in the history of a case that have a real bearing upon the diagnosis.

The **particular methods** of diagnosis vary with the general character of the case, and with the locality of the affection. We shall try to indicate these in their proper places, and would here only mention that there are many plans which may be adopted, and possibly with equal advantage.

Nothing will conduce more to correct diagnosis than the practice of note-taking and of committing to writing the diagnosis of a case and the reasons to be urged in support of it. We would venture to press this point upon the attention of students, and to assure them that any time so spent will yield them a full reward in the readiness, confidence, and accuracy in diagnosis it will produce.

The results of our examination of the patient are the most important facts for purposes of diagnosis; for the evidence so obtained is mostly, if not wholly, objective, and is also skilled evidence. To show how the data thus obtained, combined with others, enable us to diagnose various morbid states is the chief purpose of the following chapters.

The **examination of the patient** should in all cases be as complete and careful as possible, no point being omitted because of its apparent want of bearing upon the case. The interest and practical importance of local lesions is so great that there is a grave danger lest in our view of the disease we lose sight of the subject of it, and fail to complete the local examination by a comprehensive survey of the patient as a whole.

The examination should be **systematic, precise,** and **purposive**; the investigation of symptoms should be conducted in some regular order, and each question, each manipulation, each part of the examination, should have some definite object. To conduct an examination in this way not only promotes accuracy of diagnosis, but also tends to facilitate and expedite it, because it necessitates the surgeon using his mind and his senses together. Its value is often conspicuously seen in the way two men will examine a tumour: one of them in a few moments will have learnt all its characters, while the other, after a more prolonged examination, will have ascertained little or nothing about it, and will be unable to speak definitely and with assurance as to its nature; and this may be not so much from want of absolute knowledge as from ineptitude and the want of a definite aim and purpose in the examination.

Students from the first should form the habit of taking **single precise observations,** and not trust to mere repetition for ensuring accuracy.

Whenever the results of examination can be stated in numbers, this should be done, as in the case of the temperature, pulse, respiration, measurements of all kinds, number of fits, frequency of micturition, etc.

Care is required in making even the simplest observation, such, for instance, as counting the pulse, or measuring the length of a limb. Where a single observation leaves a doubt upon the observer's mind it must be cleared up by repeating the observation, but we should like to insist upon the great importance of forming the habit of relying upon a single observation. It is only too common to see the manipulation for the detection of fluctuation repeated several times before the observer is sure of the result; similarly, a patient with a scrotal tumour is made to cough several times before it is decided whether the act causes an impulse in the swelling or not; and it would be easy to multiply similar examples.

As far as possible, **objective phenomena** must be observed by the surgeon himself. For instance, a patient's statement that he cannot swallow must not be accepted until his attempt and failure to do it have been seen; in this, as in many like cases, pain in an act is often spoken of by the sufferer as inability to perform it. **Subjective symptoms** must be separately investigated and their true value carefully appraised.

Further, in an increasing variety of morbid conditions help is afforded by X-ray examination, chemical, cytological, or bacteriological investigation. And the examination is not to be considered complete until the appropriate investigations have been made. The results must be interpreted in the light of the clinical examination in arriving at the final diagnosis.

CHAPTER II

PAIN

THE first point to determine in the investigation of any pain is its **exact situation and extent,** for, if these correspond to the peripheral distribution of a nerve, it shows that the cause of the pain is irritation either of the trunk of the nerve or of one of its visceral branches; in the latter case the pain is known as "referred."

The situation and extent of the pain may correspond to the anatomical distribution of a particular nerve-root, indicating irritation at a point nearer the spinal cord than the formation of individual perpheral nerves.

Pain caused by irritation of sensory nerve-endings is felt in the area of irritation independently of the anatomical distribution of a nerve. For example, pressure upon the trunk of the ulnar nerve in the arm is felt as pain in the little and the ulnar side of the ring fingers; while the pain of a boil or an abscess is purely local.

Pain of neurotic origin is distinguished by the absence of an adequate local cause and the want of correspondence with the anatomical distribution of sensory nerves.

Much light is afforded by noticing whether **tenderness** is associated with pain, and, if so, how it is elicited. Thus, the absence of all tenderness to pressure or movement in a painful part is strong evidence that the source of the pain is not local; for instance, when pain is complained of in the knee, and the joint is found free from all tenderness to pressure or from pain on movement, the cause of the pain is not in that joint, and will probably be discovered in the hip-joint. Other illustrations are afforded by the pain felt in the foot in cases of aneurysm pressing upon the internal popliteal nerve, or the pain felt in the testicle in cases of renal calculus. The surgeon must make this examination with caution, because the association of pain and tenderness is so frequent, and probably in the patient's experience so constant, that he will certainly expect pressure or movement to give pain, and he may be so much on the alert to detect its first onset that he may unconsciously deceive the examiner.

The manner in which tenderness is elicited greatly aids in diagnosis. If, for instance, the lightest contact causes pain, it indicates irritation of the cutaneous nerves, either local or referred; if the skin can be handled freely, perhaps pinched up, without causing pain, while pressure upon the deeper parts (muscles or bones) excites pain, it shows in the same way that the nerves of these deeper structures are affected. When the hyperæsthesia of the tissues close under the skin is very intense, and they lie superficially, as for instance in the case of periostitis over the inner surface of the tibia, the gentlest pressure upon the skin is at once transmitted to the inflamed periosteum and causes pain; to make the distinction in such a case requires great care.

Another very useful and important method of testing hyperæsthesia is to observe **how the pain is affected by movement.** Movement excites pain if the muscles used in the act are inflamed or are the seat of pain, or if parts put on the stretch or compressed by the movement are tender, or if the parts moved one upon another are sensitive. Where any particular movement is painful it is important to notice if the pain occurs equally whether the movement be active or passive. For example, if it is found that active abduction of the arm is painful, but that the arm can be put into the same position by the surgeon without causing pain, provided the patient's abductor muscles are kept relaxed, it shows that it is the contraction of the muscles, and not the movement or the position of the limb, that causes the pain.

Fascial and ligamentous pain is elicited by any movement that stretches the ligament or fascia, whether active or passive. Take such a case as is presented in *lumbago*. If, when the patient bends well forward, pain is excited, and is relieved by his rising into the vertical posture by contraction of the lumbar muscles, the seat of the pain is in the lumbar fascia and not in the muscle. But if in the flexed position of the spine there is no pain, but acute pain is caused by any attempt to extend the spine, it is clearly a case of lumbar myalgia.

In all **joints** there is a considerable range of movement in which no ligament is placed on the stretch, but during which the articular surfaces are in contact, and passing over each other with more or less pressure; hence, if such range of movement is painless it is a good indication that the joint surfaces themselves are not tender; while, on the other hand, if the smallest degree of passive movement is painful, it clearly shows that the interior of the articulation is tender.

Similar principles find a somewhat different application in other situations, as, for example, in the bladder, where the pain of vesical calculus is specially caused by the contraction of the bladder on the stone, and is relieved by the passage of urine into the viscus with relaxation of the contraction and floating of the stone. In acute cystitis, on the other hand, the chief pain is produced by the contact of the urine with and stretching of the inflamed mucous surface, and by the contraction of the inflamed muscular tissue, and it is relieved after the act, to be again exacerbated as the urine accumulates. The knowledge of the way in which pain is spontaneously produced or increased is thus of great diagnostic value.

By the **character of the pain** something may at times be learnt. The itching, burning, smarting pain of cutaneous and mucous inflammations, the deep boring and aching pain of bone inflammations, the shooting, lancinating pains of "neuralgic" origin, or of those due to central lesions, and to pressure upon and partial destruction or inflammation of nerve-trunks, and the "lightning-like" pains of locomotor ataxy, are all illustrations of this fact. Paræsthesia or anæsthesia with pain is most frequently due to central nervous lesions, but may be of purely local origin, as in the case of commencing gangrene.

When there is a history of severe or of long-continued pain, it should be noticed whether there is any evidence of the **constitutional influence of the pain.** Pain exerts a depressing influence upon the central nervous system, and when intense or very prolonged its ravages are always visible. If, therefore, the account of the pain given by the patient corresponds with the *facies*, it receives important corroboration. If, on the other hand, there is no correspondence between the two, and with cheerful face and healthy countenance a patient describes himself as in great suffering, or as having recently suffered severely and for a long time, it will convince the surgeon that the statement is exaggerated, or that the pain is functional. Such a fact may render important aid in diagnosis, and may usually be corroborated by finding that when the patient's attention is engaged he permits of pressure, manipulations, and movements which, when his attention is directed to the part, he would describe as "distracting," or "intense," or "unbearable," or by some similar term. The correspondence of all the facts about a given pain is a point of great importance, and the absence of it often enables the surgeon to give an opinion in otherwise difficult cases of "hysteria."

CHAPTER III

REDNESS AND LIVIDITY

The colour of a part depends upon the amount and distribution of the blood in it, upon the general aeration of the blood, the local vigour of the circulation, or upon the escape of blood from the blood-vessels, except when a **dye,** accidentally or intentionally applied, simulates true discoloration. But the peculiar colour, uniformity of tint, and removal by a good wash readily reveal this latter condition.

When gentle pressure with the finger causes a temporary blanching of the compressed part, it shows that the blood is still within the vessels; when pressure upon the part makes no alteration in its colour, it shows that the blood is outside the vessels. In this way we distinguish between *hyperæmia* and *extravasation* of blood.

Hyperæmia, or excess of blood within the vessels, may be due to one of three causes: excess or enlargement of blood-vessels, dilatation of arterioles, venous obstruction or stasis. To distinguish between these conditions attention must be paid to the colour, the temperature, the presence of swelling, the sensation in the affected part, and also to the rapidity of flow of the blood in the vessels and to the history of the condition.

The *colour* is an indication of the oxygenation of the blood, a bright colour indicating arterial hyperæmia, and a dark colour venous hyperæmia; but in general cyanosis even arterial hyperæmia is livid in colour. An increase of local temperature always indicates arterial hyperæmia, and local coldness is always an indication of retarded venous circulation.

If the redness is **associated with swelling**, an attempt should be made to estimate their dependence one upon the other. Marked hyperæmia may be quite unattended with appreciable swelling, as in blushing; it may be attended with slight swelling, as in cutaneous erysipelas; or associated with considerable swelling, as in abscess or in œdematous intertrigo. Where redness is one of the phenomena of inflammation, swelling will always be found with it; it may, however, be so little marked as not to be noticeable as enlargement of the part so much as in a certain increase in its tension, or consistence. Prolonged active hyperæmia leads to increased growth of a part, and passive and obstructive venous hyperæmia always causes swelling from œdema.

Further, a swelling may be wholly composed of enlarged vessels, which give a colour to it, as in nævus. Greatly swollen parts may become hyperæmic, or even inflamed, as the result of friction or of dirt; the patches of intertrigo in connexion with large pendulous tumours, scrotal hernias, or the œdema of Bright's disease, afford illustrations of this. To distinguish between these various associations of swelling and hyperæmia, we must note, if possible, the order of succession of the two conditions, and the relative area of each.

The rapidity with which the colour returns to a hyperæmic part that has been blanched by temporary pressure with the finger, is an important indication of the activity of the circulation: it is immediate in inflammation or nævus; it is rapid in great venous congestion; it is slow in oncoming gangrene or in the languid circulation of approaching death.

Finally, the association of **alteration of sensation** with hyperæmia is to be noted. Inflammatory hyperæmia, and indeed nearly all active hyperæmia, is attended with pain or increased sensitiveness. When, on the other hand, there is a combination of numbness, or loss of the normal acuteness of sensation, with hyperæmia, it indicates a failure of the local processes of nutrition, unless indeed the two phenomena own one common cause in some affection of the nervous system; this will be shown by other signs, such as motor paralysis.

Extravasated blood in living tissues undergoes certain changes in colour which are familiar to us all in a common bruise, and by noting these colours, particularly the yellow, we can form some idea of the age of the extravasation. Where the extravasation is associated with the death of the tissues, being either a cause or a consequence of gangrene, these changes do not occur, but the part assumes a peculiar leaden hue; a greenish tint may be seen in places, but there is never the bright-yellow colour so characteristic of the later stage of a bruise. The marked flaccidity of the tissue, its insensibility and its coldness, are other evidences of the death of the part. (*See* Chap. XXIII.)

CHAPTER IV

DIAGNOSIS OF THE CONSTITUTIONAL EFFECTS AND OF CERTAIN COMPLICATIONS OF INJURIES AND OPERATIONS

THE **immediate constitutional effects** of surgical injuries and operations are produced in one of three ways: (1) by *direct injury* to the main vital organs, the heart, the lungs, and the brain; (2) by *loss of blood;* and (3) by what is known as *shock.* As examples of the first may be cited a wound of the heart, impaction of a foreign body in a bronchus, and concussion of the brain; as an example of the second, a ruptured spleen; and as an example of the third, an extensive burn. Symptoms due to paralysis of the vaso-motor centres in the medulla may be caused by an injury to any part of the body, however distant from the brain; they may also be induced by very strong emotional disturbance, particularly fear. Such symptoms are often designated shock. They are of a paralytic nature, and, when severe and continued, the patient's vital processes are all depressed, and to this condition the name of collapse has been applied; but where shock ends and collapse begins, none can pretend to say. Again, when the symptoms are mainly cardiac, or when, although well marked, they quickly pass off, they are often called *syncope.*

It will be readily understood that such a use of terms can easily lead to confusion, and this has been the case. The better plan is to reserve the term *shock* for the impression made upon the afferent nerves of a part or upon the emotional centres, which when conveyed to the medulla oblongata exerts a paralysing influence upon the vaso-motor centres and causes *collapse*. No confusion can occur if the *cause is called shock* and the *effect is called collapse*.

The intensity of **shock** depends upon the nature and severity of an injury and upon the part injured. The resulting collapse varies not only with the intensity of the shock but also with the instability of the nerve-centres. Thus children, nervous women, and old persons show the effects of shock more markedly than do robust men, and intense preoccupation or self-control may prevent or postpone the collapse ; the many instances in which, in the intense excitement of a battle, soldiers have received very severe injuries without their causing any appreciable collapse at the time are striking examples of this fact.

In consequence of the rapidity of all nervous processes, the effects of shock and of direct injury to the nerve-centres are instantaneous, but under certain circumstances the resulting collapse deepens ; thus progressive loss of blood may lead to such a feeble circulation through the medulla that further paralysis of the vaso-motor centre is produced. The combination of the effects of shock and of hæmorrhage is very frequent. There are cases, too, where the injury increases, e.g. extradural hæmorrhage, and then the symptoms are progressive in their intensity. On the other hand, the effects of hæmorrhage, except in cases of furious bleeding, where death is practically instantaneous, are always cumulative. Cases of *deferred shock* do, however, occur. They are of two kinds: in some, as already mentioned, an intense, exciting, mental emotion, such as rage, inhibits the effect of shock, and only when the passion passes off can the resulting collapse develop. In other cases, especially railway accidents, the horror of the scene, or its haunting memory, or alarm, is superadded to the actual physical injury, and causes collapse to come on some little time after the physical injury was inflicted. In cases of prolonged operations, especially upon viscera, collapse may only develop towards the end of the operation, supervening then from the cumulative effects of the steps of the operation, and of hæmorrhage, together with, in some cases, the effects of the anæsthetic and the depressing influence of exposure.

When the symptoms are due to injury of the great nerve-centres, the nervous phenomena are most marked; when they are due to shock from some distant lesion, the great vital functions are more uniformly affected; and when they are due to hæmorrhage, the most pronounced nervous symptoms are postponed to a late period of the gradually increasing illness.

Every injury produces some degree of shock, and a corresponding fall in blood-pressure. The resulting **collapse** varies from a disturbance so slight and transient as to pass unnoticed, up through all grades, to that which causes instant death. Many severe injuries are attended with more or less grave hæmorrhage, or with direct injury to the brain, and therefore a combination of the three conditions is very frequent. The fact, too, that the symptoms of the three states are so closely similar —all of them being depressed vital conditions—adds a further difficulty to the diagnosis. As recent injuries are often associated with conditions such as apoplexy, epilepsy, and alcoholism, which are quite independent of the injuries but are liable to give rise to considerable difficulty in diagnosis, it will be well to consider the diagnosis of the following conditions:

Shock or collapse.
Hæmorrhage.
Concussion of the brain.
Compression of the brain.
Apoplexy.
Epilepsy.
Alcoholic intoxication.

The points to be investigated are the time when the symptoms developed, their mode of onset, whether sudden or progressive, the state of consciousness and of muscular tone, the pupils, the reflexes, the pulse, the temperature, the colour of visible mucous membranes, the respiration, the occurrence of convulsions or paralysis, and the blood-pressure. Further, the mode in which the symptoms pass off is frequently significant.

1. If immediately after an injury a patient becomes cold, apathetic, or even unconscious, with all his limbs flaccid and motionless, and the pulse is small and frequent, the blood-pressure low, the respiration shallow and noiseless, the pupils dilated and contracting slowly under the stimulus of a bright light, the reflexes sluggish, and the mucous membranes pale, the condition is *collapse due to the shock* of the injury. The symptoms are characterized by uniformity in distribution; all the vital functions are about equally depressed.

2. If after an injury a patient becomes gradually weaker, e.g. first unable to walk, then having to lie down, with increasing pallor and anæmia of mucous

surfaces until they become quite colourless and the face waxen in appearance, with a small frequent pulse which becomes less and less perceptible and more and more running, and if with these symptoms there are sighing respirations, dyspnœa, restlessness (at times mental excitement), the symptoms are those of *collapse due to hæmorrhage.* A blood-count will show a great loss of red blood-cells—secondary anæmia. Consciousness may be preserved almost to the last, and a convulsion may precede loss of consciousness.

3. When a patient presents the above general symptoms, but it is observed that the mental phenomena are out of proportion to the feebleness of the circulation, there being apparently complete unconsciousness, the patient only being roused to mutter when shouted at or severely pinched, while the pulse is plainly felt at the wrist, and the patellar reflex is present and equal on the two sides, *concussion of the brain* is to be suspected; and if there are no signs of paralysis or convulsions, while there is a history of a blow on the head, or of a general shake of the body with immediate onset of the unconsciousness, the diagnosis is established. As will be mentioned later on, the symptoms of concussion vary greatly in intensity, from slight vertigo up to instant death; but they are always sudden in their onset, immediately succeeding the injury causing them, and the cerebral phenomena are the most marked and the most enduring, unconsciousness often lasting for many hours after the pulse has fully recovered.

4. Where there is definite paralysis, or complete unconsciousness, and yet the circulation is good, the pulse full, the blood-pressure high, the respiration deep, perhaps stertorous, the face injected, and the skin warm, we have to do with *compression of the*

brain or with *apoplexy*. For the distinction between these, *see* pp. 92, 94.

5. Where in a recently injured person there are signs of convulsions, or a history of such, followed by coma, and there is blood about the mouth from a bitten tongue, and evidence of involuntary passage of urine, and the knee-jerks are increased or, more rarely, absent, the case is undoubtedly one of *epilepsy*.

6. *Alcoholism*, in a degree short of producing unconsciousness, may complicate the diagnosis of the constitutional effect of an injury. Its features are almost too familiar to need description, but special notice should be taken of the flushing of the face and surface generally, the unsteadiness of all muscular actions, as seen in the tremor of the tongue and the stumbling gait, and the mental inco-ordination, shown by the incoherent talk, often foul or foolish, the inability to grasp an idea, or the obstinacy with which a false idea is held.

The surgeon must not forget the possibility of the *entrance of air into a vein*, or the occurrence of *cardiac or pulmonary thrombosis*, as a complication of an injury or an operation.

The **secondary constitutional effects of injuries or operations and diseases** are—

Reaction.
Fever.
Fat-embolism.
Thrombosis.
Delirium tremens.
Tetanus.
Hydrophobia.

Collapse, unless fatal, after a time passes off and is succeeded by reaction. The earliest signs of **reaction** are a rise of blood-pressure and an improvement in the pulse, sighing respiration, a return of warmth to the surface slight voluntary movements, and sometimes vomiting. Reaction is complete when the surface is warm and consciousness is restored; it is generally attended with restlessness, heat and dryness of skin, and abiding quickness of pulse. If, however, the patient is restless, unable to sleep, and even delirious, with hot dry skin, anxious flushed face, quick bounding or sharp compressible pulse, weak tremulous movements, thirst and frequent vomiting, and hurried respiration, the condition is known as **prostration with excitement.** These symptoms are sometimes met with after severe hæmorrhage, and if they do not end in recovery the pulse becomes fluttering and very quick, the skin cold and clammy, and convulsions and coma usher in death.

Diagnosis of surgical fevers.—All surgical fevers are now regarded as the result of toxæmia; in nearly all cases the toxins are produced by organisms. The fevers are classified into—

- I Non-infective or aseptic fever—traumatic fever.
- II. Infective or septic fever, due to—
  - (*a*) Sapræmia, including gas gangrene and erysipelas.
  - (*b*) Septicæmia.
  - (*c*) Pyæmia.

Traumatic fever is due to toxins produced in a recent wound without the agency of organisms. It is characterized by its early onset, short duration, and very slight intensity.

Sapræmia, or septic intoxication, is due to the absorption from a wound of the toxins of organisms which have not passed into the blood, at any rate in the living state.

Septicæmia is characterized by the presence in the circulating blood of living infective organisms in addition to their toxins, and *pyæmia* denotes the condition in which secondary foci of suppuration arise from the lodgment of colonies of bacteria, usually carried in portions of disintegrated clot.

These forms of fever not only vary in intensity and duration, but they may merge one into the other. They all tend to assume the asthenic type, and this becomes more marked as the disease advances.

1. If the fever comes on within the first twenty-four hours of an injury, is of slight intensity—the temperature not rising above 102° F., nor the pulse above 100—and subsides within forty-eight to seventy-two hours, and is unattended with any grave symptoms of illness—nothing more than slight headache and a little anorexia—it is *traumatic fever.*

2. If the fever comes on acutely with a smart rise of temperature—perhaps to 104° F.—rapid soft pulse, furred tongue, anorexia, headache, marked malaise, constipation (sometimes there is diarrhœa), and on thoroughly cleansing a wound, or opening an abscess, or cutting sutures and so evacuating an infective exudation, the temperature falls to the normal, and all the symptoms subside, it is a case of *sapræmia* or *pyrogenic intoxication.* A bacteriological examination of the blood shows it to be sterile.

3. If, shortly after the receipt of a wound—a few hours to two or three days—accompanying a sharp rise of temperature, rapid pulse with falling blood-pressure, vomiting, and pain around the wound, the surgeon finds swelling of the part, with resonance and possibly crepitation over a rapidly extending area, the skin being at first blanched, then mottled

with purple patches, and still later of a greenish-yellow colour, and the discharge from the wound stains the dressing orange, it is a case of *gas gangrene*, due to infection of the wound by one or more of the following anaerobic organisms, viz. *Bacillus Welchii*, *Vibrion septique*, *Bacillus œdematiens*. The odour, like that of stable-manure, given off by such a wound is quite characteristic. Muscle, if exposed in the wound, is seen at first to be of a dirty-red colour; later it becomes black with a shiny surface.

4. If during the healing of a wound the patient suddenly has a rigor, or is sick, and has frontal headache with anorexia, malaise, quickened pulse, and abrupt rise of temperature, and on examining the wound it is found unchanged or shows arrest of the process of healing, while the neighbouring lymphatic glands are swollen and tender, and if in a few hours this is followed by a bright-red, raised, painful, and tender blush, spreading from the wound with abrupt edge, the disease is *erysipelas*.

5. But if with symptoms of sapræmia the blood is found to contain staphylococci or streptococci, or if the fever does not subside with the evacuation of all infective exudation and thorough cleansing of suppurating surfaces, and yet there are no secondary abscesses and no succession of rigors, it is a case of *septicæmia*. There may be a single initial rigor.

6. If in the course of a case of septicæmia the patient has rigors at irregular intervals, each rigor being accompanied by a great rise of temperature, and soon followed by a profuse sweat with an abrupt fall of temperature, and if with these rigors secondary suppurations in joints or serous membranes or other parts occur, or evidence of infarcts in lungs, liver, spleen, or kidneys can be obtained, the case is one of *pyæmia*.

7. When in cases of prolonged suppuration it is found that the patient is steadily losing flesh and becoming increasingly anæmic, that there is a febrile exacerbation every evening, when the skin of the hands and feet feels hot and parched to the patient, and a bright-red flush is noticed on the cheeks, which is in marked contrast to the surrounding pallor, and that in the early morning this is succeeded by a fall in temperature with profuse perspiration, and the pulse is soft and frequent, from 90 to 120, gradually becoming weaker and more frequent, the condition is *chronic sapræmia* or *hectic fever*. The tongue is clean and glazed, the appetite (at any rate at first) fair, but later on becomes capricious, the bowels are often loose, the urine scanty and loaded; the mind remains quite clear.

Diagnosis of constitutional complications and sequelæ other than fevers.—If, in a patient suffering from injury to a bone (especially a comminuted fracture of the shaft of a long bone), when the collapse from the shock has passed off—usually one to three days after the injury—there are sudden symptoms of dyspnœa, with rapid laboured respirations and increasing cyanosis, although auscultation shows the air to enter and leave the lungs freely, and the pulse becomes frequent, irregular, and weak, the action of the heart being turbulent, and if with this there is hæmoptysis, or fat is observed floating on the surface of the urine, the diagnosis of *fat-embolism* must be made. When severe, the condition passes into one of coma and ends fatally. Fat-embolism in a minor degree, which gives rise to no marked symptoms, is said to be a frequent if not constant phenomenon in all cases of fracture. The condition is to be distinguished from *collapse*, the result of the injury, by its occurrence at the interval of a day or two after the injury; and from *pulmonary embolism* by its occurrence at an earlier period than that sequela, which is most common in the third week, as well as by the particular nature of the accident, and the presence of fat in the urine in the cases in which that excretion can be examined.

If a patient who has been in the habit of indulging freely in alcohol becomes restless and unwilling to take food, and is unable to sleep on the second or third day after an accident or operation which keeps him confined to bed, the surgeon may suspect the oncoming of *delirium tremens.* And if a few hours later he finds his patient still more excited, delirious, with some fixed idea of a disagreeable character which makes him constantly busy (avoiding an imaginary foe, for example), with marked muscular tremor of the limbs, lips, and tongue, jerky voluntary movements, and the skin is bathed in a foul-smelling sweat, the tongue large, moist, covered with a white or brownish-white fur with sticky mucus adhering to its sides and to the teeth, and there are thirst, complete anorexia, constipation, dilated pupils, and rapid, soft, often dicrotic pulse, the delirium tremens is fully developed. When occurring after an accident or operation it is sometimes called *traumatic delirium,* but, as it does not differ in essential characters from idiopathic delirium tremens, it is better not to use a separate name for it. The taking of food and the securing of sleep are the two signs of improvement in this condition. If, on the other hand, the tongue becomes dry and brown, the delirium incoherent and muttering, and the patient cannot be made to answer questions, or if epileptiform convulsions interrupt the other symptoms, it indicates increasing nervous prostration, and death, heralded by complete coma, generally ensues. There is a marked tendency to the occurrence of low hypostatic pneumonia in severe cases of delirium tremens, and the surgeon should therefore carefully examine the chest every day.

When during convalescence from injury or operation the patient complains of pain at a distance from the wound, and the part is found to be moderately tender, examine carefully for any sign of *thrombosis of a vein.* If the tenderness is chiefly marked along the course of a vessel, or if a vein can be felt as a firm cord, or if there is œdema of the parts drained by the vein, the diagnosis is assured. The examination must be made with the greatest care lest the clot should be displaced. The thrombosis occurs with much greater frequency in the common femoral vein than elsewhere. The onset of the condition is accompanied by a rise of temperature.

If a patient with a recent suppurating wound, or a wound but recently healed, complains of pain and stiffness about the muscles of the back of the neck, and on examination these muscles are found firm from tonic contraction, and if a voluntary effort to bring them into action causes a painful spasm in them, or, preceding these, there occur spasms of the muscles of the wounded limb, the onset of *tetanus* is to be feared. And if this tonic spasm quickly spreads to the muscles of the jaw and the face, then to those of the trunk, and eventually to those of the limbs (the hands usually remain free), while paroxysms of painful and very intense spasm occur in the affected muscles, the mind remaining clear, the diagnosis of tetanus is established. A careful search should be made in the wound secretion for the tetanus bacillus. Cases of tetanus are divided into (i) *acute*, with a short incubation period, a very rapid course with frequent paroxysms and high temperature; (ii) *chronic,* coming on later—up to three weeks—after a wound, and in which the progress of the disease is more gradual and the intensity less marked; and (iii) *idiopathic,* when the disease arises without being immediately preceded by any known breach of surface.

Tetanus is distinguished—(1) from simple *muscular spasm* by the occurrence of paroxysms of violent tonic contractions; (2) from *spinal meningitis* by the cerebro-spinal fluid being found normal on lumbar puncture, by the absence of pain and tenderness down the spine, of shooting pains in the trunk and limbs apart from the paroxysms of contraction, and of marked superficial hyperæsthesia, by the order in which the parts are affected, by the freedom of the hands and feet, and by the absence of palsy except from exhaustion in the last stages of the disease; (3) from *epilepsy* and *hystero-epilepsy* by the absence of unconsciousness, and the great liability to a fatal issue from apnœa, syncope, or exhaustion; (4) from *strychnia poisoning* by the more gradual onset of the symptoms, the longer course of the disease, and the less frequency of the attacks of opisthotonos (strychnia poisoning is usually fatal in twenty-four hours), by the commencement and chief intensity of the disease in the muscles of the neck, jaw, and face (strychnia affects first and most the muscles of the lower limbs, then those of the trunk and the muscles of respiration); (5) from *hydrophobia* by the persistence of the muscular rigidity between the paroxysms, by the intense trismus as opposed to the marked laryngeal spasm of hydrophobia, by the absence of delirium or mania, and often by the shorter incubation period and the absence of the history of a bite of a rabid animal. (6) In *tetany* the spasm is limited to a single group of muscles, usually in a limb, and pressure upon the nerve supplying these muscles always excites the spasm. If the tetanus bacillus can be detected in the wound, the diagnosis is at once established.

If a patient has been bitten by an animal suffering from rabies, and at some interval subsequently, usually between three weeks and three months, he becomes very depressed in spirits, sleepless, apathetic, irritable, or restless, and this is succeeded by a spasmodic attack brought on by an attempt to drink, the spasm affecting chiefly the muscles of the larynx, face, and those of inspiration, and ending in complete muscular relaxation; if this is succeeded by similar and more severe attacks, always brought on by some external excitation, such as the attempt to drink, or even the sight or thought of water, a sudden noise or bright light, a puff of cold air, or the contact of the hand; and if with these symptoms there are great mental excitement and restlessness running on to paroxysms of maniacal frenzy, fixed and terrible illusions, or irresistible impulses, with intervals of calm in which the patient may sleep, the diagnosis of *hydrophobia* may be made. In some cases vesicles have been found around the frænum linguæ, but their significance is doubtful. If the patient does not die in the acute stage from respiratory or cardiac spasm, he passes into a state of gradually increasing palsy, in which the mind becomes clear only to be again clouded by the increasing asthenia preceding death.

The signs by which hydrophobia can be distinguished from tetanus have been already given, but it must be carefully distinguished from what is called *false hydrophobia*, which may be a wilful or an unintentional close imitation of the real disease, presenting, when ending fatally, great difficulty of diagnosis. Chief reliance must be placed on discovering whether the patient has been concentrating his thoughts and attention upon the disease, constantly reading and talking about it, or dreading its onset, and on noting the occurrence of exaggeration of the symptoms, such as barking noises, snapping of the jaws, running about on all fours, and so on, which are all popular delusions concerning the disease. Where recovery follows, the diagnosis of false hydrophobia becomes extremely probable, some would even say certain. Whenever possible, care should be taken to ascertain whether the animal suspected of inoculating the patient suffered from rabies.

CHAPTER V

DIAGNOSIS OF INJURIES OTHER THAN WOUNDS

THE diagnosis of a case of injury should include the determination of the following four facts:

1. The *local characters* of the lesion—its seat, nature, and extent. It must not be forgotten that more than one injury may be caused by a single accident.

2. The *effects of the injury upon the patient's constitutional state;* these may be immediate or remote.

3. The existence of *local conditions which share in the production* of the lesion.

4. The presence of any *local or constitutional state that may influence the repair* of the injury or *the treatment* to be adopted.

The examination of the case should be methodical and, if possible, complete. In every case the history of the injury should be carefully noted, first with a view to estimating its possible and probable effects, and secondly to detect any want of correspondence between the alleged cause and the observed effects. Any marked modification of the symptoms usually associated with a particular injury should be specially noted.

As the presence of an external wound affects the mode of examination of an injured part and the way in which a diagnosis of the injury is arrived at, as well as the prognosis and treatment of the case, we will consider in this chapter the diagnosis of injuries in which there is no external wound.

1. **Examine the skin and subcutaneous tissue, and notice especially any swelling and change in colour.**—i. A dark-red or purplish discoloration of the skin, which is not dissipated by pressure, is due to a recent effusion of blood into the skin, and is called an *ecchymosis* or *bruise.* The effused blood goes through the well-known colour changes, and later on causes merely a yellow stain. When the bruise appears at an interval after an injury it indicates that the source of the hæmorrhage is deeper than the skin, and that it has taken some time for the blood to travel to the surface. As examples of this may be remembered the ecchymosis of the eyelids in fracture of the roof of the orbit, staining of the skin of the groin in fracture of the neck of the femur, and of the loin in cases of hæmothorax and of laceration of the kidney.

ii. Swelling in the skin and subcutaneous tissue, coming on immediately or rapidly after an injury, is caused by the escape of blood or air, or of one of the fluid secretions, into the cellular tissue of the part. If the swelling is very soft, elastic and crepitant, it is due to the presence of air, *surgical emphysema.* Such a swelling gives a tympanitic note on very light percussion. It is only met with in connexion with injuries of the lungs or trachea, or of the air-containing cavities of the skull.

Injury of the urethra or bladder may be at once followed by the escape of urine into the cellular tissue of the perineum, scrotum, and penis, or of the pelvis and hypogastrium; injury of the kidney may be followed at a longer interval by escape of urine into the cellular tissue of the loin; fracture of the vault of the skull may be followed by escape of cerebro-spinal fluid under the scalp, and the formation of a fluctuating swelling—*traumatic meningocele.* With these exceptions, fluid swellings immediately following upon injuries are due to the escape of blood. When the blood forms a distinct fluctuating tumour it is called a *hæmatoma.* When the blood is poured out from a single large artery, and the opening in the vessel wall remains patent so that a large swelling is formed, and the parts around the fluid blood are compressed to form a spurious sac, it is called a *circumscribed traumatic aneurysm.* When the blood infiltrates the planes of cellular tissue without forming a circumscribed swelling it is spoken of as an *extravasation of blood.* (*See* Chap. XVII.)

Hæmatoma is generally combined with a certain amount of superficial bruising. The collection of blood may long *remain fluid*, or it may *coagulate*, and the presence or absence of fluctuation will determine this point; occasionally such a swelling *suppurates*, or, more strictly, the tissues around it become inflamed and suppurate. This has to be distinguished from simple inflammatory œdema following the tissue laceration, and is recognized (*a*) by increased and progressive swelling; (*b*) by surrounding œdema; (*c*) by heat and redness of the part; (*d*) by severe pain of a throbbing character; (*e*) by pyrexia of a suppurative type: sometimes there are chills or even a rigor, and sweating.

iii. The presence over a bruised part of blebs containing blood-stained serum of a deep-red or brown colour is an important sign of fracture of a subjacent bone. These blebs are often extensive, and to the uninitiated have a threatening look; they do not really add materially to the gravity of a case. They must be distinguished from the blebs caused by burns, in which the clear serum quickly coagulates, and from those of gangrene, which are accompanied by other signs of tissue-death. (*See* Chap. XXIII.)

iv. When the amount of extravasated blood is out of all proportion to the nature of the injury, the patient, especially if a male, is probably the subject of *hæmophilia*.

2. **Examine the bone.**—Carefully compare the injured with the corresponding uninjured part of the body, first with the eyes, then with the hands and, in some cases, also with the measuring tape. Whenever possible such an examination should be completed by the taking of one or more X-ray pictures. A good skiagram will afford definite evidence in a case of doubt, and the additional information it gives when the bone is known to be injured is of the greatest value.

The special clinical signs of injury are—

Deformity.
Mobility in the length of the bone.
Crepitus.
Acute localized pain and tenderness.

Deformity.—If any difference between the two sides is noticed, ascertain whether they were symmetrical before the injury. It has been shown that perfect symmetry in the limbs is not so general as was formerly believed to be the case, and a difference in length of the two limbs must not be taken as a proof of fracture or dislocation unless supported by other evidence. The asymmetry which is not the result of gross congenital malformation, of previous injury, or of disease, affects each segment of a limb, while that resulting from injury affects only one segment. For example, if in measuring the two lower limbs one is found ½ in. shorter than its fellow, if this shortening is merely congenital asymmetry the thigh and leg will each be found to be about $\frac{1}{4}$ in. shorter than its fellow; if, however, this shortening is due to a fracture of the femur, the measurement of the leg will be found the same on the two sides and the difference will be limited to the thighs. In comparing two limbs, they should be placed in the same position and measured from exactly the same bony points.

When the hand is passed carefully over the injured bone it may detect both alteration in outline and local tenderness. A suddenly produced alteration in the shape of a bone can only be the result of a fracture. The deformity may be extreme, obvious to the eye, as in the common fracture of the clavicle, or there may be no deformity at all, as in many cases of a fracture of a rib. Between these extremes all grades are met with. The deformity also varies in nature—it may be a bend in the bone or a crushing-in of the bone; the broken ends may be slightly displaced or quite separated; or, again, a detached fragment may be tilted out of place.

In examining the bone these details should all be noticed and an attempt be made to find out the direction of the plane of fracture, the nature and extent of the displacement, and, if possible, the number of the fragments. This examination must be made gently and carefully so as not to give unnecessary pain and not to bruise or tear the soft parts nor unintentionally to disimpact a fracture.

Mobility in the length of a bone is determined by grasping the part firmly with one hand close above and the other hand close below the seat of the injury, and, first gently, and then more vigorously, attempting to move the one part upon the other. If any movement or crepitus is detected it is enough, but if not, more force is gradually used and the whole length of the bone explored, until it is ascertained that no part of it is movable on the rest. The movement upon one another of the fragments of a recently broken bone causes a quite characteristic grating called *crepitus ;* it is simulated only by the rough sensation felt in a joint in cases of advanced osteo-arthritis or of Charcot's joint disease. When the fracture has occurred at an epiphysial line the crepitus is softer in character, as the two surfaces are cartilaginous rather than bony. The movement of the ends of a broken bone is painful, except in those suffering from paralysis or tabes dorsalis ; this examination should therefore be made as gently as possible, and should not be repeated when once the mobility or crepitus has been felt.

A fracture is generally *acutely tender*, and if, on running the fingers along a bone, one spot or part is found to be acutely sensitive, it is strong presumptive evidence of a fracture there ; the pain may, however, be due to a bruise of the periosteum.

X-rays enable us to see the outline of a bone, and to detect any deformity in it, even such a minor degree as cannot be recognized by the eye or the hand through the covering of soft parts. But they also show the intimate arrangement of the bony lamellæ—the structure of a bone—and enable us to recognize the disturbance of this structure produced by a fissure, even when there is no displacement. By the X-rays many fractures are recognized that cannot be otherwise diagnosed, and, as the use of this method is both painless and harmless, it is of very great value. A good skiagram does much more than demonstrate the existence of a fracture, for it also shows the direction and amount of displacement of the fragments, the existence of comminution or impaction, and in some cases the presence of a foreign body, such as a bullet.

In regard to the use of X-rays for diagnosis, two or three cautions may be given. In the first place, skiagraphy should always be preferred to the use of the fluorescent screen; it is only in a skiagram that precise details can be appreciated. Skiagrams should be taken in two planes, or stereoscopic pictures should be made. A slight fissure may be visible in one plane only, and the character of displacement can only be fully revealed in a stereoscopic picture. Even with these precautions it requires an expert in the interpretation of skiagrams to detect a fracture in some cases. Then it is necessary to warn the inexperienced against the fracture-like appearances at the epiphyses of immature bones: this source of error is easily avoided by taking an exactly similar skiagram of the opposite and uninjured member. But the companion picture must be exactly similar; sometimes, by a little alteration of the angle at which the skiagram is taken, the appearance of a fracture may be very closely simulated. Lastly, it must be remembered that skiagrams are shadowgrams, and that the distance of the bone from the photographic plate exaggerates the deformity or displacement that is present. The correct use of skiagrams in the diagnosis of injuries and diseases of bone requires experience and some amount of expert knowledge, and is not the extremely easy matter that some have thought.

The **injuries of bone** are contusion, fracture, separation of epiphyses.

A *fracture* may be fissured, incomplete, impacted, or complete; any one of these may be simple or compound, and may be comminuted or multiple. A *separation of epiphysis* may be simple or compound.

Severe local pain and tenderness at the site of a direct injury to a bone, without either alteration in the shape of the bone, shortening, mobility in its length, or crepitus, are the signs of a *bruise of the periosteum and bone* or of a *fissured fracture.* It is impossible to distinguish with certainty between these injuries without a good skiagram; many cases that were formerly diagnosed as merely contusions of bone, or sprains, are now shown by the use of X-rays to be cases of fissured fracture. The more diffused and dull the pain, the greater the probability of its being only a *bruise;* the more acute and the more precisely localized the pain and tenderness, and the longer these severe symptoms last, the greater the probability of its being a *fissure of bone.*

In a child a bone may be found bent, and the direct distance between its two ends shortened, as the result of an injury, without either mobility or crepitus at the bend. This is an *incomplete* or *greenstick fracture.* It is most often seen in the clavicle and the forearm, but may be met with in other long bones; it always results from indirect violence. It must be distinguished from a *rickety* curve in the bone, and from the deformity sometimes caused by congenital *syphilis.* Both of these deformities are chronic, gradually produced, and, as a rule, symmetrical, and associated with other signs of rickets or syphilis. It is important, however, to remember that a greenstick fracture is more liable to occur in a rickety than in a healthy child.

When, as the immediate result of direct violence to a bone, there is alteration in its contour and length, but no mobility at the seat of the supposed fracture and no crepitus, there is an *impacted* fracture. It is distinguished from incomplete fracture by the age of the patient and by the deformity (when this can be clearly made out) not being a rounded curve in the bone. A skiagram is the most certain means of demonstrating an impacted fracture. The lower end of the radius and the upper end of the femur are the most frequent seats of impacted fracture.

Mobility in the length of a bone is proof of a *complete* fracture. In such a case some or all of the following signs will be met with: altered contour of the bone if the fragments are displaced; alteration in the length of the limb if there is overriding or separation of the fragments; rough crepitus if the fragments are in contact; localized pain and tenderness at the seat of fracture, at once greatly increased by any movement of the fragments; and swelling. Bones are very vascular structures; their fracture is followed by a good deal of hæmorrhage, and in a few hours this is succeeded by free serous exudation. The swelling in the overlying soft parts may lead to the formation of blebs containing coloured serum. The patient may say that he heard the snap of the breaking bone.

When a bone breaks under ordinary use or from a very slight injury, it is the result of some previous change in the bone, and is called a *spontaneous* fracture. Tumours of bone, fragilitas ossium, atrophy of bone, and locomotor ataxy are the chief causes of this form of fracture, and evidence of one or other of these conditions should be sought for. A wound, whether in skin or mucous membrane, extending down to the seat of fracture, converts the injury into a *compound* fracture: all other cases are *simple* fractures.

If mobility is obtained with great ease, and is accompanied with marked and readily elicited crepitus, suspect a *comminuted* fracture; and if manipulation shows that the bone is broken into more than two fragments (if, for instance, other fragments are felt separate from and movable upon the two main ones), this suspicion is converted into certainty. If, however, the fragments are broken off by distinct fractures, it is called a *double* fracture. Comminution is generally easily detected in compound fractures, as the fragments can be felt, but is often overlooked in simple fractures, especially when small splinters or fragments are detached from the deep aspect of a bone. When a sharp-pointed fragment, not including the whole thickness of a bone, is detached, it is spoken of as a *splintered* fracture.

If a fracture occurs in the position and direction of the junction of an epiphysis with a diaphysis, in a person under 20 years of age, and if the crepitus is softer and less distinct than in a common fracture, it is a *diastasis* or *separation of an epiphysis*. This is most commonly seen at the lower end of the radius and femur, and the upper or lower end of the humerus. It is a grave injury, as it is liable to affect the subsequent growth of the bone.

A good skiagram enables us to recognize with precision all these details in various fractures of bones, and is to be relied upon whenever available in preference to other methods of diagnosis.

3. **Examine the joint or joints.**—This examination must be systematic, and should determine (i) whether there is any displacement of the articular end of a bone, and if so, to what extent; (ii) whether there is any fracture into the joint; (iii) whether there is any laceration of ligaments, or (iv) effusion into the joint.

i. Compare carefully the same joints of the two sides of the body, and determine whether the articulating bones retain their normal relative position; any modification of this is a *dislocation*, which may be *complete* or *incomplete*. The two signs of dislocation which are unmistakable are the absence of an articular end of bone from its normal situation, and its presence in an abnormal position; and the student must not forget that the diagnosis should be made to rest upon these phenomena, and not upon mere alterations in contour and measurement, which, although depending directly upon the displacement, may yet be simulated by other conditions. It is only where, from special conditions, these signs can not be clearly and directly elicited that the indirect evidence of displacement of a bone must be relied upon. For example, an empty glenoid cavity, and the head of the humerus resting on the ribs just below the coracoid process, are absolute signs of a subcoracoid dislocation of the shoulder, and are of more value than a number of such observations as flattening of the shoulder, alteration of the axis of the arm, certain limitations of movement, and so on.

ii. The articular end of a bone must be examined for fracture in the same way as the rest of the bone. A good skiagram will enable the surgeon to distinguish at once a *fracture into a joint* from a *fracture near a joint.* Apart from X-rays, a fracture into a joint will be diagnosed when (*a*) the position of the fracture necessarily involves this injury—e.g. transverse fracture of the patella; (*b*) a part of the articular surface can be identified as detached; or (*c*) there is rapid effusion of blood into the joint.

A skiagram affords the most precise and reliable information as to the exact nature and extent of the injury of articular bone.

iii. Examine the movement of the joint, and notice (1) the range of movement—whether it is limited or excessive; (2) any locking or sudden freeing of the joint; and (3) the pain accompanying movement.

If, after a sudden wrench or strain to a joint, it becomes swollen and painful, and movement is limited and very painful, while examination shows that there is neither fracture nor dislocation of the bones, nor rupture nor displacement of muscles and tendons, it is a *sprain of the joint.* Sprains vary greatly in their intensity. If there is an unnatural degree of mobility in a joint, as of lateral motion in the knee-joint, it indicates *rupture of the ligament* normally limiting that movement; if, on the other hand, without this unnatural extent of movement, a particular movement causes acute pain, it indicates a *stretching and partial laceration of the ligament* that is put on the stretch by the movement in question. When, however, slight movements, not extensive enough to stretch any ligaments, elicit sharp pain, and there is rapid effusion into the synovial cavity, as shown by a fluid swelling having the outline of that cavity, it indicates that the chief stress of the injury has fallen upon the synovial membrane, and that it is to be regarded rather as a *bruise and laceration of the synovial membrane.* In some cases, particularly at the knee, the joint is found rigid, or "locked," and then, with a sudden movement, it becomes free, and at the same moment something is felt, or even heard, to slip aside. This "internal derangement of a joint" is due either to a torn or displaced interarticular cartilage or tendon, or to a loose cartilage becoming caught between the bones. Great care must be taken to determine whether there is displacement of any of the structures entering into or immediately surrounding the joint —bones, interarticular cartilage, or tendons.

iv. Effusion of blood into a joint, *hæmarthrus*, recognized by the synovial cavity becoming distended immediately after an injury, is generally due to a *fracture into the joint*, e.g. fracture of the patella. In *hæmophilia* it may occur as the result of quite slight violence.

When a joint becomes distended with fluid some hours, or a day, after an injury, it indicates *traumatic synovitis*. This may be caused by any injury or irritation of the synovial membrane, especially a contusion, sprain, or fracture into or near the joint.

A severe wrench may tear away a ligament or tendon with a scale of bone attached to it. This form of injury is seen particularly often at the knee. The tendon of the *quadriceps* may be torn from the top of the patella with a thin scale of that bone, the injury being strictly a fracture. Or the *ligamentum patellæ* may be torn from the tibia with the part of the epiphysis which forms the tubercle of that bone. A skiagram will show such a lesion better than any other of our diagnostic methods.

4. **Muscles and tendons.**—Muscles may be either bruised, strained, or ruptured; tendons may be ruptured, torn away from their attachment, or displaced. (*See also* p. 210.)

Examine the part to ascertain whether there is any swelling of a muscle, or any gap to be felt in one, especially during its contraction; whether the tendons occupy their normal relation to the bones, and can be made tense; and notice, also, whether the contraction of any muscle is painful.

i. When, after a blow, strain, or prolonged and violent contraction, a muscle is found swollen, tender o pressure, with a sense of stiffness and weakness, and acute pain is produced on attempting to put it into action, the injury is a *bruise* or *strain of a muscle*; when produced by a blow it is a *bruise* (*contusion*), and when caused by over-use it is a *strain.* This latter injury is most common in the deltoid, pectoralis major, biceps, flexors or extensors of the forearm (tennis-elbow), adductor muscles of the thigh (rider's sprain), hamstrings, muscles of the calf, and the extensors of the spine.

ii. When, during a sudden and powerful contraction of a muscle, there is experienced pain—the patient often thinks he has been struck on the part by a stone or stick—followed by a sense of weakness, and on examination there is found a gap in a muscle, with swelling from effused blood, a *rupture of a muscle* has occurred. Attempts to put the muscle into action are painful and futile, and make the gap in its contour more marked.

iii. When, with symptoms exactly like those attending rupture of a muscle, there is not found any gap in a muscle or swelling over its fleshy part, and yet it is impossible to make its tendon tense or to produce its particular movement; or if a distinct gap can be felt in the tendon, as in the case of rupture of the tendo Achillis, *rupture of a tendon* may be diagnosed.

iv. When a tendon cannot be made tense by contraction of its muscle, and the skiagram shows that a thin piece of bone is detached, it is an example of the injury referred to on p. 46, the surface of bone to which the tendon is attached having broken away from the bone in place of the tendon giving way.

v. When, as the result of some sudden strain or wrench, there is acute pain, with tenderness in the course of a tendon, swelling and ecchymosis, and contraction of one of the muscles of the part excites severe pain, while its tendon is found not to occupy its normal position, a *dislocation of a tendon* has occurred. This is most frequently seen at the ankle, in connexion with the peroneus longus tendon which starts forwards over the malleolus, or at the knee, where the patella with its tendon is displaced on to the outer side of the joint, or one or other hamstring tendon is displaced. It is said also to occur in connexion with the long tendon of the biceps, causing the arm to be locked in the abducted position until set free by flexion and rotation of the shoulder.

5. **Examine the vessels.**—The signs of injury to vessels are those of interruption in the arterial and venous circulation and of considerable local hæmorrhage. These may follow the injury immediately, or develop more slowly. The surgeon should feel, therefore, for pulsation in the arteries beyond the injured part, and compare it with that in the corresponding vessels in the other side of the body; he should notice any local pallor, coldness, numbness, and loss of power, and also any venous congestion. He can estimate the vigour of the local circulation by noticing how quickly the colour returns into a part which he has blanched by gentle pressure. The amount and tension of swelling at the seat of injury are to be observed, and, where possible, the main vessels are to be traced with the fingers, and any sudden loss of the pulse in an artery or any consolidation of the vessel recognized.

i. Loss of pulsation in the arteries beyond the seat of injury shows that the lumen of the main vessel is interrupted. If this is noticed directly after an injury, and there is no great local swelling, it is due to *contusion or laceration of the artery with* *thrombosis*, the torn inner and middle coats of the vessel, together with blood-clot, having blocked up the lumen of the vessel. In some cases the blocked artery can be felt firm and pulseless.

ii. When the loss of pulsation occurs at some interval after an injury, and without great local swelling, it is due to secondary occlusion of the artery, and, if embolism can be excluded, *traumatic arteritis and thrombosis* is to be diagnosed.

iii. Where the loss of pulsation in the distal arteries is associated with considerable local swelling, it shows that the *main artery is ruptured and bleeding*. Owing to the absence of a sac there is, as a rule, neither pulsation nor thrill in the swelling. Should one or both of these signs be present, the condition is known as *circumscribed traumatic aneurysm*. The size and tension of the swelling, as well as its rapidity of growth, are measures of the rate at which the blood is being poured out into the tissues. Owing to the effused blood compressing the veins, the parts below become swollen and œdematous, and this may be followed by *moist gangrene*.

iv. If in a case of fracture or dislocation the arteries beyond are pulseless, but the pulse returns in them when the displacement of the bone is corrected, there has evidently been merely *compression of the artery*. This is a rare event; if the pressure is severe and long-continued, it is liable to be followed by traumatic arteritis and thrombosis. The rare cases of *causalgia* following such an injury are probably due to irritation of the nerves running in the sheath of the artery (*see* p. 68).

v. A rapidly formed swelling at the seat of injury is always due to hæmorrhage, except in the cases of extravasation of urine and of emphysema. The rapidity of its formation is a guide to the size of the vessels from which the blood is escaping; and when the pulse beyond shows that the main artery is intact, the source of the bleeding may be either a *ruptured secondary artery* or a *ruptured vein.*

vi. When, a short time after an injury, a vein is felt as a firm solid cord, *thrombosis of a vein from contusion* may be diagnosed. This form of venous thrombosis is limited to the injured vein, or only extends very slowly, and is to be distinguished from spreading thrombosis (*see* p. 30).

vii. In many cases the exact extent of vascular injury cannot be diagnosed. Local swelling, as already stated, is the measure of subcutaneous hæmorrhage; pallor and coldness of the parts beyond are the index of obstruction to the arterial flow, and œdema and lividity are the signs of venous obstruction. These localized disturbances of the circulation are to be distinguished from the general effects of shock and loss of blood which influence the circulation equally in all parts of the body.

6. **Examine the nerves.**—Nerves may be *contused, lacerated,* or *compressed* by subcutaneous injuries, and later on may be *inflamed,* or become the seat of *tumours.* The history of the case will determine whether the lesion is contusion from a direct blow, laceration from overstretching, or compression from the displacement of a bone, the formation of callus, or the extensive effusion of blood or other fluid. Where the injury is due to contusion, laceration, or displacement of a bone, as in a dislocation, the symptoms come on at once; but where they are dependent upon the pressure of effused blood, or of an abscess, or on the implication of a nerve in callus, they come on later. Where there is any reason to suspect an injury to a nerve, the surgeon should carefully test the patient's power of contracting all his

muscles, and the acuteness of the sensibility of the skin, comparing together the sound and the injured limbs. The exact distribution of the motor and sensory paralytic phenomena will indicate the nerve or nerves that are involved.

The **muscles** must be examined by testing the patient's power of voluntary contraction, by carefully noting their response to the faradic and galvanic currents, and by observing signs of wasting. When the patient has lost the power of voluntary contraction and the muscle does not respond to faradism, there is interference with the motor nerve of that muscle. If the response to galvanism is quite brisk, especially at the kathode, the injury to the nerve is partial. But if after a short interval the response to galvanism is a little increased, and is greater at the anode than at the kathode, or if after a longer interval from the injury the reaction to galvanism is lessened or even lost, and there is great wasting of the muscle, there is total interruption of the nerve-supply to that muscle.

As regards **sensation**, even more minute observations must be made; it is not enough to test it roughly by the finger or a pin, for sensation includes at least three varieties of sensory responses, each of which has its own path to the nerve centres, and must be separately tested.

1. *Protopathic* sensation—the response to a pin-prick, heat and cold, the sensation of pain—should be tested by the careful use of a sharp pin, and by two test-tubes containing iced and hot water respectively. Protopathic sensory nerves overlap widely, but the path of sensation is entirely confined to the posterior nerve-root, and therefore a limited and ill-defined area of protopathic anæsthesia indicates interruption in the sensory path of a nerve, while a

wide area of this form of anæsthesia shows that there is injury to a nerve-root.

2. *Epicritic* sensation — the finer tactile sensation, and the detection of small differences of temperature — is tested by gently stroking the skin with a fine tuft of cotton-wool or a very soft camel's-hair brush. Loss of epicritic sensation is usually sharply defined and corresponds to the distribution of individual nerves. A well-defined area of epicritic anæsthesia indicates injury to the corresponding nerve or nerves, and if the area of epicritic anæsthesia is smaller than the area of protopathic anæsthesia the injury is to a posterior nerve-root or roots—for epicritic sensation may reach the nerve-centre through adjacent uninjured nerve-roots.

3. *Deep* sensation, by which we appreciate firm pressure, and the position of a part—the "muscular sense"—is not conveyed through cutaneous nerves or the posterior nerve-roots, and it passes up the same side of the spinal cord. If this sensation is lost on the side on which there is superficial anæsthesia, it indicates an injury to both anterior and posterior nerve-roots. Superficial anæsthesia on one side associated with deep anæsthesia of the corresponding part of the other side of the body indicates a unilateral lesion of the spinal cord on the side of the loss of muscular sensation. Loss of sensation of all kinds up to a well-defined circular line ("stocking anæsthesia") and flaccid paralysis without loss of electrical reaction in the affected muscles indicate hysteria.

As late consequences of nerve injury various forms of **trophic change** must be noted. The skin may be rough, scaly, pale, and dry, or thin, congested, glossy, and moist, with a tendency to vesication, suppuration, or ulceration. The hair and nails may be broken short or shed, or the nails may be ridged, and there may be ulcerative paronychia. The muscles and bones may be atrophied. Joints, especially of the fingers and toes, may be ankylosed, and the growth of a limb may be arrested. The temperature of the part is always lowered. When the skin is rough, pale, and dry it indicates that the nerve supply of the part is completely interrupted without irritation. But when the skin is thin, moist, congested, and glossy, and there is a tendency to ulceration, it is a sign of irritation of the injured nerve, as by the pressure of callus or the presence of a foreign body.

It is very important to recognize at once an injury to important vessels and nerves; and particularly when there is some more obvious lesion present, such as a fracture or dislocation, care must be taken that attention to this does not lead to the overlooking of the less obvious mischief.

CHAPTER VI

DIAGNOSIS OF WOUNDS

When called to see a recent wound, the surgeon has to determine three things—(1) the nature of the wound, i.e. the kind of injury that has been inflicted upon the tissues; (2) the parts that have been injured, and (3) its constitutional effects. These effects have been dealt with in Chapter IV.

In many cases a glance will suffice for the diagnosis, but in others great care is required to arrive at a correct opinion, and serious mistakes may be made if the examination is not thorough, the division of nerves or tendons, or the presence of foreign bodies, or the commencement of gas gangrene being overlooked.

It is always important to know how a wound was inflicted, whether by a sharp or blunt instrument, by one liable to remain, or break off, in the wound, or by one likely to carry in infective or poisonous material. The position of the wound is the next most important point to note, and it will suggest the parts possibly injured and the special examination that must be made. The superficial extent, the depth of the wound, and its direction are other points usually quickly determined. If the wound has to be "explored" to ascertain its depth, or to feel for a foreign body, care must be taken not to infect it—the finger or probe must be sterilized—and not to start a fresh hæmorrhage from wounded vessels which have been occluded by clots. The amount and character of any hæmorrhage, the colour of the blood, its mode of escape, whether in a jetting or a steady stream, from distinct spots or from the whole surface of the wound, and the pulse and state of the circulation in the parts beyond the wound, must be noted. The escape from the wound of any other fluid than blood must be recognized. The sensation in the parts beyond a deep wound should always be tested to determine whether a nerve-trunk has been divided. Severed muscles and tendons can often be seen; in other cases it is necessary to test whether the patient is able to use his muscles, to move each joint, and to make certain tendons tense. Foreign bodies may be seen or felt, and those that are opaque to X-rays can be demonstrated by a skiagram. In making these examinations the condition of the bone or bones will be ascertained. The state of the circulation and the sensation in the actually wounded tissues must be taken note of; and in gunshot wounds particularly the colour and vascularity of exposed muscle must be noted, as well as the presence of fine bubbles of gas in the discharge. Lastly, the constitutional accompaniments of the wound must be observed, especially to determine whether they do or do not correspond with the direct effects of the injury and the amount of external hæmorrhage.

Having made this examination, the surgeon will know the kind of injury that has been inflicted, and the parts that have been injured.

I. **The nature of the wound.**—The features of recent wounds only will here be spoken of.

1. If the wound is a simple clean cut through the skin or other tissues, the appearance of the skin quite up to the edge of the wound being unaltered,

and the surface of the cut being smooth, showing the different structures cut through, it is an *incised* wound.

2. If the surface of the wound is dark in colour and uneven, and the skin around it is livid, ecchymosed, and more or less cold and benumbed, it is a *contused* wound.

3. If the surface of the wound is extremely irregular, with long shreds of tissue adherent to it, it is a *lacerated* wound.

Contusion and laceration are often combined, and the wound is then spoken of as a *contused lacerated* wound. Incised wounds are much the most painful, the pain being of a sharp stinging or burning character; in contused and in lacerated wounds the pain, much less severe, is of a dull, aching, or benumbing character. Incised wounds bleed freely from their whole surface; contused and lacerated wounds are attended with much less hæmorrhage, even when large vessels are injured.

4. The shape and superficial extent of wounds vary within the widest limits; only two varieties require notice here. One is where a distinct flap of tissue has been cut or stripped up; such a wound is to be called a *flap* wound, "incised" or "lacerated" being added as a prefix, according to circumstances. The other is where the depth of a wound is out of proportion to its superficial extent, a *punctured* wound. And as these may be inflicted with sharp, clean-cutting instruments, such as knives, or with blunt weapons, such as round bullets, they may have the characters either of incised or of contused wounds.

5. In the case of contused or flap wounds, it is important to determine whether the tissues have been *injured beyond recovery*. In some cases flaps are so nearly severed that it is obviously impossible

for the circulation to be maintained in them, and tissues may be so crushed and mangled that their vitality is evidently destroyed. Whenever there is any doubt, the parts should be preserved; and if, after the patient has recovered from the primary shock and the general circulation is re-established, there are no signs of circulation in the part, if compression makes no alteration in its colour, and if it remains cold and quite senseless, it may be decided that the part is actually dead; but these signs must be unequivocal before such a diagnosis is to be made. Where they are not thus plain the occurrence of post-mortem changes in the dead tissues and the absence of all signs of repair will presently distinguish the dead from the living parts.

6. If the local or the constitutional effects of a wound are not explicable by the extent and severity of the injury and the hæmorrhage, it is an *infected* or *poisoned* wound. The particular symptoms vary, of course, with the poison: in one case it may be coma from morphia; in another, tetanic convulsions from strychnia; in a third, suppuration; in a fourth, septicæmia; in a fifth, erysipelas or lymphangitis; in a sixth, gas gangrene; in a seventh, convulsions from tetanus or hydrophobia; in an eighth, spreading gangrene; in a ninth, local induration and the constitutional effects of syphilis.

II. **The parts injured.**—1. Injury to the *skin* or *mucous membrane*, as the case may be, is obvious; if the wound extends through the *whole thickness of the skin*, it gapes, and allows the subcutaneous fat to be seen. If muscular tissue, known by its deep-red colour, or tendons (glistening white bands) are seen in the wound, the *deep fascia* has been divided. A cut into *muscle* is also obvious. *Complete division of a tendon* is determined by noticing (*a*) that the patient is unable to execute the particular movement accomplished by the muscle in question; (*b*) that he is unable to make the tendon tense; (*c*) in some cases, that the retracted muscle forms a distinct swelling; and (*d*) sometimes that the divided tendon, one or both ends, can be plainly seen in the wound, the proximal end being drawn upon when the patient tries to put the muscle in action. The loss of power caused by division of a motor nerve is easily distinguished from that due to a severed tendon by noticing that it affects muscles at a distance from the wound. For example, in a wound at the wrist, division of a tendon, let us say the flexor carpi ulnaris, will cause loss of power in that muscle only; while if the ulnar nerve is severed, the short muscles of the hand, which are quite removed from the seat of injury, are paralysed.

2. An oozing of bright blood from the whole surface of the wound is *capillary hæmorrhage.*

3. A rapid continuous flow of dark blood from one or more points of the wounded surface is *venous hæmorrhage.* Venous hæmorrhage is not attended by local blanching, nor by interference with the pulse in the arteries beyond; it is lessened or stopped by moderate pressure on the distal side of the wound, and increased by moderate pressure on the cardiac side; firm pressure on the cardiac side, by stopping the arterial flow to the part, of course stops, but not instantly, loss from a wounded vein. If a large vein is opened, such as the axillary or jugular, the blood spurts from the wound, but the flow, however rapid, is continuous and even.

4. If, at the same time that a vein is wounded, a sucking or hissing sound is heard, and the blood is noticed to be frothy, *air has entered the vein.* This complication is only likely to occur when a

large vein in the neck or axilla is wounded; that is, sufficiently near the thorax for inspiration to produce a negative pressure in the veins. If the air enters in any quantity it produces sudden death, or severe symptoms of cardiac failure, such as pallor, dyspnœa, and a very rapid weak pulse.

5. A rapid flow of bright-red blood from a particular spot in the wound, the blood being forced out in a jet and *per saltum*, is *arterial hæmorrhage*. If the patient is cyanosed, the blood from an artery may be dark in colour, but by its remittent flow will be readily distinguished from that coming from a vein. Arterial hæmorrhage may, however, lose this character under two circumstances: (*a*) if the blood does not escape directly from the artery, but passes along a more or less narrow or sinuous wound, its jetting flow is lost; and (*b*) in the case of small arteries, where, from loss of blood or from obstruction, the arterial tension is considerably lowered, the flow may become continuous; it is, however, distinguished then from capillary oozing by its escape from a definite spot in the wound, and from venous hæmorrhage by its colour, its control by pressure above, and the failure of distal pressure to stop it. When a large artery is wounded, such as the carotid, femoral, or axillary, the blood issues with a distinct hissing noise. In the case of an artery wounded in its continuity, it may be possible to determine what vessel is injured by noticing if there is (*a*) blanching of any part, as e.g. of the sole of the foot in division of the posterior tibial artery during tenotomy; (*b*) loss of pulse in the artery beyond. Thus if, with a wounded artery at the root of the neck, the pulse in the carotid or facial artery and the brachial or radial is unaffected, it proves that neither the carotid nor the subclavian

artery is the one injured. Similarly, in the case of a stab in the thigh, if the pulse in the tibial arteries is equal on the two sides, it shows that the femoral trunk is not wounded. In many cases the position of the wound is enough to determine what artery is wounded; but in many others it is uncertain until the bleeding vessel is actually found, and its exact relations to surrounding structures are seen.

6. Anæsthesia and motor palsy in the parts beyond an injury show that a *nerve* has been severed. The area of paralysis will determine the extent of the nerve lesion. (*See* p. 51.) A divided or partially divided nerve may be visible in a wound.

7. Complete division of a bone in a wound is evidenced by the usual signs of *fracture*, i.e. mobility in the length of the bone, crepitus, and irregularity of the outline of the bone; the fragments are often visible. Where a bone has been only partially severed, a so-called *wound of bone*, the signs of complete fracture are absent; the injury can be detected either by the eye, or by the finger or probe feeling the cut in the bone, or by X-rays. The association of a fracture of a bone with a wound of the soft parts is a very important one, for if the latter extends down to the broken bone it forms a *compound fracture.* To determine whether this is the case is usually quite easy, as one or other fragment may protrude from the wound, or be visible in it, or the finger or probe introduced into the wound may at once detect the fracture. In other cases it is equally apparent that the wound is quite superficial, perhaps a mere abrasion, or at some distance from the fracture, the latter not being compound. In a third series of cases the student may be in doubt, and then the amount of hæmorrhage from the wound will be the best indication. Bone is a very vascular tissue,

and if from a small wound, over and complicating a fracture, there is a free trickle of bright blood continuing for some hours, it is very strong evidence of the fracture being compound.

8. Escape of a clear, ropy, tenacious fluid from a wound, either pure or mixed with the blood, indicates that a *synovial cavity* has been opened. If the wound is immediately over a bursa or synovial sheath, and the fluid small in amount, and especially if a tendon is exposed in the wound, it may be diagnosed as a *wound of a bursa or synovial sheath ;* but if the wound is directly over a joint, and the quantity of fluid more than a drop or two, it is probably a *wound of the joint.* In extensive wounds there is no difficulty in determining whether a joint is injured or not, as the articular surfaces are exposed, or project, or portions of articular cartilage may be chipped off and be found free in the wound. It is in the case of small punctured and incised wounds that the difficulty arises. Whenever there is doubt, the case must be treated as a wounded joint, and if the part swells out with effusion into its articular cavity the diagnosis of a wounded joint may be considered to be established; similarly, where a bursa becomes distended, evidence is afforded of a wound extending into it. The exact position and direction of a wound, together with the amount of synovia escaping, are the best guides in deciding between a wound of a bursa and a wound of a joint. In many cases of doubt a careful exploration of the wound should be made.

9. *Wound of a serous cavity* is only certainly determined by the exposure of one or other of the contained viscera, or of the smooth, glistening surface of the serous membrane. Should a dropsical accumulation have been opened, the amount of fluid escaping would be decisive. In all cases where there

is any doubt the wound should be carefully explored to make the diagnosis quite certain. Injury of the serous cavity of the head is in some cases characterized by a continuous flow of the cerebro-spinal fluid, and occasionally by a peculiar symptom, viz. a spurting forth of the cerebro-spinal fluid when the jugular veins are compressed. (*See* p. 82.) Wound of the pleura without wound of lung occurs but rarely, and is difficult of diagnosis unless there is collapse of lung or prolapse of unwounded lung. (*See* p. 140.) In some cases air can be heard being sucked into and expelled from the pleural cavity with each act of respiration. In the belly the *omentum* is the viscus that most often protrudes, and it must be distinguished from the subcutaneous or the subperitoneal fat by its peculiar granular appearance, its distinct circumscription, and in some cases its reducibility ; it may be irreducible and strangulated, and then its livid colour will be very distinctive. Next to it the *small intestine* most often protrudes. In the scrotum the smooth, glistening *testicle* may protrude.

10. The diagnosis of *wounds of viscera* is considered in the chapters devoted to local injuries.

11. The diagnosis of *wounds of the ducts of glands* rests upon the position of the wounds and the flow from them of characteristic secretion, such as saliva, milk, bile, or urine.

III. **Subsequent progress of the wound.** —The healing of a wound is in all cases effected by the organization of the exudate poured from the living wounded tissues. Under the varying conditions of wounds the phenomena of the healing process differ. When the edges and surfaces of a wound are in apposition, all that is noticed is that they become glued together, and that the union, at first soft, becomes gradually firmer as the scar is organized—*healing by first intention.* In the case of an open wound the surface is seen to become glazed over with a film of lymph which levels up all its smaller shallows and conceals the details of the surface. The lymph quickly becomes pink, then raised up into granulations, and these are seen to grow until the wound is filled up to the level of the skin; then epithelium grows over the granulations from the edge, and the scar undergoes its final developmental changes; this is called *healing by second intention.* Sometimes a combination of these two forms of healing occurs; surfaces which have become covered with granulations may, if brought into apposition, adhere to one another—*healing by third intention.* In other cases a cavity in a wound is allowed to fill up with blood-clot, and the whole clot organizes into a scar *en masse*, i.e. without the gradual growth of granulations from the surface—*healing by organization of a blood-clot.* The process of healing is unattended with the signs of inflammation—heat, redness, pain, and fever. It is liable to be interfered with by *hæmorrhage*, *gangrene*, *infection* of the wound, *retention of discharge*, the presence of a *local irritant*, severe *constitutional debility*, or *movement* of the healing surfaces. When healing is complete the function of the part may not be restored, and the scar may undergo various changes or become the seat of disease.

The diagnosis, then, of the subsequent progress of a wound consists first in the recognition of the way in which healing is occurring, secondly in the recognition of any disturbances in that process, and thirdly in the estimation of any failure in the completeness and permanence of the repair. The constitutional complications of wounds have been dealt with in Chap. IV. Here we consider the local conditions only.

1. If the surfaces of a wound are found to be in apposition and adhering, it is healing by *primary union* or *first intention.*

2. When the surfaces of a wound do not directly adhere, but the tissues composing them become obscured by a translucent layer of coagulated exudate, it is said to be *glazed;* and if this becomes pink, raised into minute conical elevations which grow up towards the surface, the wound is healing by *granulation* or *second intention.* And when at the edge of the wound the granulations become quite even, a little darker in colour and then bluish on the surface, this is due to the formation of *epithelium.* The blue colour is soon followed by a white line, and these changes spread centripetally until the whole surface is healed over. In contused and lacerated wounds, shreds of tissue are often so injured that they are incapable of repair, and they are thrown off as grey or yellow masses of varying size which gradually become detached and separated in the discharge. This process of *cleaning* of the wound precedes active healing, and is attended with free serous or purulent discharge.

3. If opposing granulating surfaces become directly adherent, in place of the cavity between them being filled up by the growth of the granulations, it is called healing by *third intention.*

The diseases of granulating wounds are considered in connexion with *ulcers* (Chap. XXI.).

4. When, in a wound which has become wholly or in part filled up with blood, the clot does not soften, but after several days a thin dry layer of it separates and exposes a cicatrix, the process is called *healing by organization of blood-clot.* This only occurs

in aseptic wounds and where there is no tension in the tissues. In small wounds it has long been familiar as *healing under a scab.*

5. A wound may be found not to undergo any change whatever, even for many days after its infliction ; a little dark blood oozes from it, but the natural appearance of the severed tissues is in no way obscured, and there is no union between adjacent surfaces. This *delayed healing* is only occasionally seen, and arises from severe constitutional debility or from diabetes. As a late symptom, delay in healing, or even the breaking down of union already accomplished, may attend erysipelas, pyæmia, and some other severe constitutional affections.

The skin edges of deep wounds sometimes unite slowly, particularly when there is interference with the blood supply to the extreme edge of the skin. Movement in a wound is sometimes a cause of great delay in healing.

The **local disturbances in the healing** of a wound arise from—

Hæmorrhage { External.
  Concealed.
Imperfect drainage.
Wound infection.
Gangrene.
Necrosis.
Presence of foreign body.
Escape of a secretion.

External hæmorrhage.—Bleeding occurring from a wound within the first forty-eight hours is *intermediary* or *recurrent hæmorrhage*, and is due to failure of the primary arrest. Bleeding coming on later than this is *secondary hæmorrhage*, and only occurs in infected wounds. A little trickle of bright blood from the deeper parts of a wound occurring spontaneously some days after its infliction is probably the forerunner of an extensive secondary arterial hæmorrhage; it should therefore never be overlooked or slighted. There is often a rise of temperature just before a secondary hæmorrhage. Secondary venous hæmorrhage is sometimes met with; and there is a form of parenchymatous or capillary hæmorrhage occurring in large wounds in very debilitated subjects as an intermittent oozing that continues off and on for a few days. Lastly, there is the more abundant recurring hæmorrhage of *hæmophilia.*

Swelling occurring in a wound is the result of either concealed hæmorrhage, retained serum, or inflammation. Notice the consistence and outline of the swelling, the presence or absence of œdema, redness, ecchymosis, or tenderness, and the character of the pain and the constitutional disturbance. A defined swelling, coming on early, showing no tendency to increase, and with an absence of superficial redness, œdema, tenderness, or marked pain, is due to *concealed hæmorrhage.* If the swelling is plainly fluctuating, the blood will be found fluid, mixed with serum: such swellings are never very tense; the temperature is a little raised. If the swelling is tense and elastic, it is caused by a blood-clot; the clot may give the sense of fluctuation. If the swelling is less well defined, firm, and especially if the skin over it is ecchymosed, it indicates an extravasation of blood in the cellular tissue; this occurs chiefly in such parts as the eyelids, scrotum, and labium. A fluid swelling in a wound without the signs of inflammation is generally found to be a collection of *serum.* When the swelling is progressive, ill-defined, tender, the skin over it slightly reddened and œdematous, and the pain constant, while the temperature and pulse are raised, it is due to *inflammation*, and will run on to *suppuration.* In the early stages the swelling is firm, later on it becomes soft and may "point," and the more superficial the seat of the inflammation the sooner will fluctuation be detected. The periphery of the swelling is always firm. Some of the fluid from the wound should be examined bacteriologically to determine the infecting organism.

If the parts about a wound implicating a bone are found much swollen, and the periosteum is separated, leaving the bone dry and bare, *acute osteo-myelitis* is present. In a case of amputation a soft fungous mass will protrude from the end of the medullary cavity, and the probe passed into this meets with no resistance and possibly liberates some pus. In these cases there is abundant suppuration and high fever.

For *gangrene* occurring in a wound, *see* p. 307; and for *erysipelas, gas gangrene, septicæmia, and pyæmia,* p. 25 *et seq.*

Incomplete repair. — When a *wound remains unhealed* it is generally due either to the presence of some local irritant such as a bullet or portion of clothing, a buried suture or ligature, or a sequestrum, or to disease such as tubercle, actinomycosis, or cancer, to the turning-in of the skin edges, to the escape of some secretion along the wound such as saliva, urine, fæces, or mucus, to imperfect drainage, to movement of the unhealed parts, to adhesion of the wounded parts to unyielding structures, or to the application of local irritants by malingerers. Other causes of much-delayed healing of a wound are very defective circulation as in Raynaud's disease, the loss of trophic nerve influence, X-ray or radium burns, and diabetes.

The wound may be healed, but the function of the parts may not be restored. If the parts below the wound are cold, weak, a little benumbed, and the arterial pulse is absent or weak, it indicates that a main artery is obstructed, and that the anastomotic circulation is insufficient.

If the parts below the wound are œdematous, or become so when used, it indicates obstruction to the venous or the lymphatic circulation, or both.

If parts below the wound are anæsthetic and muscles are paralysed, wasted, and give no reaction with a faradic current, it indicates that a severed nerve has not united, or that its function has not been restored. This has to be distinguished from the immobility of a part from division of a tendon or a muscle. (*See* p. 57.) The *position of the scar*, the *extent of the paralysis*, and the *accompanying electric and sensory phenomena* are sufficient to establish the diagnosis. If the skin of the affected part is rough and covered with dry, scaly epidermis, the *nerve or nerves are completely divided.* In cases where the skin is smooth, glossy, devoid of hair, with patches of livid red colour or of herpetic eruption, and there is burning pain, and the muscles have wasted rapidly, there has been *incomplete division of the nerve.*

When, after a wound in the neighbourhood of the main nerves and vessels of a limb, there arises immediately, or within a few days, an intense burning pain distal to the injury, exaggerated by pressure, changes of temperature, and emotional disturbance, and partly relieved by the application of moisture, it is a case of *causalgia* (syn. thermalgia). In injuries of the arm, the pain is situated in the palm, spreading thence over the distribution of the median nerve. In the case of the lower limb, the painful area is in the foot. In either case it may be accompanied by trophic changes in the skin of the painful area.

But when, after a similar injury, there succeeds rapid and extreme wasting of muscles, not only below the injury but also above, coupled with weakness, such active movements as are produced being jerky in character and the muscles responding to gentle taps with similar jerky contractions, and the parts are chilly and cyanosed, there is *functional muscular atony.*

Inability of the patient to effect a particular movement, when no obstacle to passive movement exists, and there is neither anæsthesia nor loss of faradic irritability, is the sign of a divided muscle or tendon.

Rigidity of a joint after healing of a wound is due to adhesions between the joint surfaces, or to gluing of the tendons to the wounded structures. The more complete the rigidity the greater the likelihood of its being true ankylosis. Where a tendon acts upon more than one joint, as in the hand and foot, its adhesion about a proximal joint will, of course, prevent its moving a distal joint, although the joint itself is supple.

Occasionally a joint is insecure, with abnormal mobility, from failure of repair of an injured ligament.

Affections of scars.—Scars are often *adherent*, or *tight*, or *weak*, i.e. liable to break down and slowly heal again. Their more serious affections are—

Neuralgia.
Cheloid.
Epithelioma.

Persistent pain and tenderness in a scar are the signs of *neuralgia.* Of this there are three forms which we can recognize. Where there is constant pain referred to the sensory area of a single nerve, it is due to *compression of the nerve* in the scar tissue. Where the nerve involved is a mixed nerve there will be associated with the neuralgia more or less complete paralysis of the muscles it supplies. Where the special feature of the case is exquisite tenderness at one or more spots which can be identified as in the position of nerves, the neuralgia is due to *neuroma*; and the diagnosis is confirmed if a nodule or bulbous enlargement on the end of a divided nerve can be felt. In the worst cases the pain, which is first felt only in the area supplied by the nerves divided in the wound, gradually spreads and affects the areas of additional branches or nerve-trunks. The pain is continuous, with agonizing paroxysms excited by movement or contact, or by change of temperature. It is sometimes associated with convulsive and very painful muscular contractions. The cause of this form of neuralgia is *spreading neuritis*, starting in the wounded nerves and gradually extending towards the nerve-centres.

When a cicatrix enlarges, becoming thicker, prominent, and wider, but remains firm, smooth, and of a delicate pink colour, it is a *cheloid scar*. This disease generally occurs soon after a wound has healed, but it may attack a scar at any time after its formation; after a certain advance it may remain stationary for a time, and it then disappears. It may attack a large scar in several situations. Its smoothness, firmness, slow growth, and the absence of ulceration, together with its spontaneous recession or disappearance, distinguish this disease from epithelioma attacking a scar.

When a scar becomes the seat of a nodular or warty thickening, which ulcerates and discharges a foul serous fluid, it is the seat of *epithelioma*. The steady progress of the disease, and the enlargement of the neighbouring lymphatic glands, will confirm this diagnosis.

Operation scars often become the seat of *recurrent malignant growths*, rodent ulcer, carcinoma or sarcoma, the features of which vary and resemble those of the primary disease for which the operation was undertaken.

CHAPTER VII

DIAGNOSIS OF INJURIES OF THE HEAD

Few cases are of more interest or importance from a diagnostic point of view than those of injury to the head. With the exception of the scalp, the condition of which can be thoroughly explored, it may in some cases be quite impossible to determine whether serious injury has or has not been inflicted upon various parts of the head. The skull may be extensively fractured or bruised without any obvious signs by which the injury may be recognized, and serious lesions of the cerebral membranes, or of the brain itself, may exist without symptoms enabling the surgeon to diagnose them. From this it follows that the utmost care must be expended upon every case of head injury, as those apparently trivial may be really most grave.

Diagnosis being beset with so much difficulty, it becomes especially important that the examination of the patient should be systematic and thorough. The mode of procedure which is at the same time the simplest and the best is to search first for signs of injury to the *scalp and pericranium*, then for those of *fracture of the bone*, and finally for those indicating *lesion of the contents of the cranium*. The affections of each of these three groups of tissues are—(1) *primary*, those produced more or less directly by the injury, and present immediately, or within a few hours; and (2) *secondary*, those which result indirectly from the injury, and come on after an interval of days or even months.

I. Injuries of the Scalp

Primary effects.—*The scalp may be wounded or bruised.* Notice the depth of the wound, whether its edges gape and the pericranium or the bare bone is exposed, and if either of its edges is separated as a flap. Observe the amount of hæmorrhage, the position of bleeding-points, signs of bruising of the tissue, the presence of hair, dirt, etc., in the wound. A splinter of bone or soft grey brain-matter in the wound must not be overlooked. If the edges gape, the wound is certainly through the occipito-frontalis, and extends at least into the "dangerous area" beneath it; if the wound does not gape, it may or may not be a wound through the whole thickness of the scalp, and this fact therefore must not be considered as excluding injury to the cranium (*see* below). The effects of contusion are not so apparent in the scalp as elsewhere, and, owing to the smooth convexity of the skull, blows with a blunt weapon usually cause incised wounds. In some cases large portions or even the whole of the scalp may be completely torn away.

A swelling that forms over the vault of the skull within a few hours after a blow or squeeze is due to either blood (*cephalhæmatoma*) or cerebro-spinal fluid (*traumatic meningocele*) under the scalp. To distinguish between these two conditions, look for discoloration of the skin, test for fluctuation in all parts of the swelling, carefully feel for any hardening of its edge, see if the swelling is translucent, and if it pulsates or becomes more tense during crying or coughing. If it fluctuates in part only or indistinctly, or if there is a firm edge to the swelling, caused by coagulation of some of the blood, or if the scalp is discoloured or the swelling opaque and unaffected by crying and straining efforts, it is a *hæmatoma*.

A **cephalhæmatoma** may be in the scalp, or beneath the aponeurosis, or under the periosteum. To distinguish these varieties, notice whether the outline of the swelling corresponds to that of a bone, or to the attachments of the aponeurosis, and also whether the swelling can be moved with or under the scalp.

1. If the swelling is firm, more or less flat, and moves with the scalp over the subjacent bone, it is a *hæmatoma in the scalp*.

2. If the swelling is soft or fluctuating, giving in places a soft crackling sensation to the fingers, and is not distinctly movable over the bone, it is a *circumscribed subaponeurotic hæmatoma*.

3. If the swelling is soft and fluctuating, and easily movable over the bone and under the scalp, being capable, perhaps, of passing from the occipital protuberance to the supra-orbital arch, and from zygoma to zygoma, the whole scalp, indeed, being detached from the pericranium, it is a *diffused subaponeurotic hæmatoma*.

4. If the swelling is fixed to the bone, while the scalp is movable over it, and if it corresponds in outline to one of the cranial bones, it is a *subpericranial hæmatoma*. This form is most often met with over the parietal bone in children at birth, being caused by the pressure of the mother's pelvis or the forceps. When the margin of the swelling is firm—either from coagulation of the blood or from effusion and more or less complete organization of lymph—while the centre remains soft, it may be mistaken for a depressed fracture. The distinction can, however, be made by noticing that the firm edge of

the swelling is compressible, and when indented by pressure the bone may be felt passing in an unbroken curve from beyond it into the centre of the swelling, and also by feeling that the firm edge is raised above the bone outside it. In a case of depressed fracture the hard edge is not raised above the bone beyond it, nor is it compressible, while the bone within is felt to be distinctly below the proper level. A good skiagram will show the presence or absence of a fracture.

5. If the swelling pulsates, and the pulsation is lost when the superficial temporal, occipital, or supra-orbital artery is compressed, or when all these vessels together are compressed, while coughing and straining do not make the swelling more tense, the tumour is a *pulsating hæmatoma* or *diffuse traumatic aneurysm* due to the communication of a large artery with the effusion of blood. This diagnosis is confirmed if the swelling can be moved over the bone.

Cephalhæmatomata usually undergo absorption, but the blood may remain fluid for a long time, leaving a fluctuating swelling, which will then be distinguished from similar swellings by the history of its formation. Occasionally they become inflamed and suppurate; and if a swelling which by its history and characters is recognized as a hæmatoma becomes more tense, hot and painful, very tender, with œdema around it, and the temperature is raised, it may be diagnosed as a *suppurating hæmatoma.*

In the diagnosis of the late consequences of injuries to the head, the recognition of a *scar* in the scalp may be of great importance, both as corroborating a history of a particular injury, and still more as localizing it with precision. The development of a *soft puffy swelling* in the scalp was referred to by

Pott as a valuable sign of subcranial abscess; it is also seen where necrosis follows contusion of the bone.

The **secondary complications of wounds of the scalp** are—

1. Suppuration.
2. Sloughing.
3. Delayed union.
4. Cutaneous erysipelas.
5. Cellulitis.

Examine the wound and notice whether the edges are uniting and the deep surfaces of flaps adhering to the cranium; observe also the presence of swelling, its extent and consistence, the colour of the skin, the state of the adjacent lymph-glands, and the presence or absence of fever and constitutional disturbance.

1. Pus may be found dotting the edges of the wound; where a flap of scalp has been separated, if suppuration occurs, the pus is liable to bag under the flap; this is shown by the free escape of pus on pressure. Occasionally the pus collects in a circumscribed fluctuating swelling—an **abscess.**

2. As the result of very severe contusion the whole thickness of the scalp may **slough**: limited sloughing results from inflammation, especially in contused or lacerated tissues.

3. Where suppuration has occurred, the edges of the wound may separate and become inverted and callous, and great **delay in healing** result.

4. If the skin of the scalp is found slightly swollen and tender, and the swelling extends some distance from the wound, and has a well-defined edge, the disease is **erysipelas.** The characteristic red blush is not seen in the scalp, but it appears if the disease spreads to the forehead or neck beyond the margin

of the scalp proper, and in the former case there will be œdema of the eyelids. The neighbouring lymphatic glands, i.e. the preauricular, mastoid, or occipital, will be enlarged and tender. There are well-marked constitutional symptoms—fever, headache, nausea or vomiting—and these may have set in abruptly with a shiver or rigor.

5. If the scalp is greatly swollen and boggy, pale in colour or blotchy, there is **cellulitis.** There is usually œdema of ears, eyelids, and the upper part of the neck, and the lymphatic glands are enlarged and tender. The constitutional symptoms are severe in degree—high fever, a weak rapid pulse, headache or delirium.

The secretion of the wound should be examined bacteriologically: a streptococcus, with or without other bacteria, will be found in cases of erysipelas or cellulitis.

II. INJURIES OF THE VAULT OF THE SKULL

Severe injury may be inflicted on the bone of the skull without producing any symptoms by which it can be certainly recognized. A fracture of the vault can be shown in a skiagram, and its details are best demonstrated by X-rays; its other signs are **deformity** and **escape of cranial contents.** Pass the fingers gently over the vault and note any irregularity of the surface, particularly any depression or sharp edge of bone, and any swelling. If a swelling is noticed, it should be examined for fluctuation, translucency, and pulsation. If there is a wound in the scalp, it should be examined for splinters of bone and for portions of brain matter, and then the cleansed finger, or probe, should be passed in and the bone explored. If any depression is felt, its extent and depth, as well as the direction of fissures running from it, and the presence of detached fragments, should be noticed. On holding back the edges of the wound a fracture can be seen, the broken edge of bone having a dark-red colour and an uneven surface.

The **primary effects of injuries of the bones of the skull** are—

Contusion.
Infraction.
Fracture.

1. There are no positive signs whereby a **contusion** of bone can be recognized; it is only known or suspected to have occurred when certain *inflammatory sequelæ* or *necrosis* occur. It may be inferred in all cases of severe injury to the skull, especially when not attended with fracture.

2. If in an infant at birth, or a young child in whom the skull is still soft, a shallow smooth depression in the bone, with rounded edge, is felt, it may be diagnosed as a depression or dent in the bone, or **infraction**; such a depression without fracture is only possible in quite early life. The surgeon must not mistake for an infraction the yielding of an unclosed fontanelle, or of a softened spot of bone in craniotabes; in these there is no permanent depression, only a yielding of the bone under the pressure of the finger.

3. **Fracture.**—i. If an abrupt depression of the vault of the skull, with a sharp, perhaps irregular, edge and uneven surface, can be felt through the scalp, the sharp edge not being raised above the bone outside it, and being quite incompressible, it is a *simple depressed fracture* of the vault of the skull.

ii. If on passing the fingers over the skull a sharp, irregular edge of bone can be felt, it indicates a *simple fissured fracture* of the vault of the skull; if the fissure takes the line of one of the sutures, it is a *separation of a suture.* In some of these cases mobility and crepitus may be detected along the line of fracture. Effusion of blood in or under the scalp may partially or completely obscure these simple fractures. The surgeon must not mistake for fractures the *normal sutures,* which may be felt as slightly raised ridges on the bone, and which are always smooth and somewhat rounded; nor slight smooth irregularities of the surface, which may be natural irregularities of the bone; nor the bossy elevations met with in *congenital syphilis.* The distinguishing features of all these are their elevation above the surface, not depression, and their smooth rounded outline. It is impossible to diagnose a *simple fissure* of the vault if there is no displacement of the bones, unless it can be demonstrated in a skiagram, and stereoscopic pictures afford the best means of detecting them.

iii. If, after an injury to the vault of the skull, a translucent fluctuating swelling forms over the part struck, it is a collection of *cerebro-spinal fluid beneath the scalp,* and is proof of the existence of a *fracture of the vault* with wound of the brain extending into a lateral ventricle. The swelling may begin to form at once after the injury, or not be noticed for several days; it may remain stationary, or gradually increase in size; there are no signs of inflammation in the scalp, nor of induration around the margin of the swelling; it can generally be noticed to pulsate, and to become tenser when the child cries. It has been called *traumatic meningocele.*

iv. Where there is a wound in the scalp leading down to the bone, it is easier to determine with certainty the existence of a fracture. If at the bottom of a wound an irregular red line is seen, from which, if the pericranium is torn, blood issues or may be squeezed, and especially if by pressure slight movement along this line can be detected, or if the finger-nail or the probe can be inserted into the line and detects a sharp edge of bone, there is a *compound fissured fracture of the vault.* This fissure must not be confounded with a *suture* exposed in the wound, which is not a bleeding line; nor is the edge of the *torn pericranium or temporal fascia* to be mistaken by the finger for an edge of bone. The edge of the dense fibrous membrane can in either case be recognized by its slight yielding to pressure, by its smoothness, and by its not grating under the finger-nail. The mistake, however, has been made. If such a fissure is placed exactly in the line of a cranial suture, it may be distinguished as a *separation of a suture.*

v. The finger in the wound will distinguish those varieties of fracture known as *compound depressed, comminuted, punctured, elevated, pond* and *gutter fractures.* If the bone is fissured, and there is slight depression, it may be a fracture of the *outer table* of the bone only; and similarly there may be an entire outer table and a fracture of the *inner table* alone: these conditions can only be diagnosed with certainty by a good skiagram. Where, however, from an injury inflicted on the outer surface of the bone, there is depression and splintering of the outer table, it may be inferred that there is still greater injury of the inner table, and the more nearly any fracture approaches to the form of a punctured fracture the greater becomes this probability. If a probe can be passed into a fissure and under the bone laterally, and firm bone is still felt beneath it, a *separation of the two tables* of the bone, with depression of the inner plate, is indicated.

The **secondary effects upon the bone** of injuries inflicted upon the vault are—

Necrosis.
Osteo-myelitis.
Osteo-phlebitis.

1. If a scalp wound does not heal, but on the contrary the soft parts retract from the bone, and this is seen to be dry, bare, and of a dull-white colour, there is **necrosis.** It will not be possible to tell to what depth the necrosis extends until the sequestrum separates or is removed ; but so long as there are no signs of intracranial inflammation there is no indication that the inner table of the bone is involved. Necrosis of the bone may occur from contusion without a wound in the scalp. It will then be indicated by a puffy swelling of the scalp, which when cut into exposes bare, dry, dull-white bone.

2. There are no positive signs whereby **osteomyelitis** and **osteo-phlebitis** may be recognized with certainty before they have led on to their more serious consequences, necrosis, pyæmia, and thrombosis of the sinuses. But if, two or three weeks after an injury to the head, there is pain in the head, with fever, and tenderness of the skull when pressed upon through the scalp, or there is a slight deep swelling of the scalp, *osteo-myelitis* may be suspected.

III. FRACTURE OF THE BASE OF THE SKULL

The signs of fracture of the base of the skull are *hæmorrhage*, *escape of cranial contents*, and *injury to cranial nerves.*

The **hæmorrhage** varies in amount according to the size of the vessel or sinus injured. Its special features are its appearance at a distance from the part struck, the depth from which the blood flows, and, in many cases, its long continuance. The blood may escape from the ear, nose, or pharynx; and in the latter cases, if the patient is recumbent, as he generally is, the blood is swallowed, and the hæmorrhage may only be revealed when altered blood is vomited. In other cases the blood trickles into the orbit, gradually forcing its way forwards under the conjunctiva, and then into the lids. If the fracture passes through the orbital arch, the blood escapes at once into the upper eyelid. In fracture of the posterior fossa the blood gets into the intermuscular planes of cellular tissue below the occiput, and only after some days reaches the surface and discolours the skin in this region.

Cerebro-spinal fluid escapes when the arachnoid membrane is torn, e.g. the arachnoid sheath of the olfactory lobe or of the auditory nerve. It may flow in considerable quantity from the ear or the nose, and the loss may continue for days. The flow is increased by anything that raises the intracranial pressure, such as coughing, straining, or compression of the internal jugular veins; this sign should not be sought for, as the raised tension may affect the brain injuriously. The fluid is clear and limpid, specific gravity about 1002, faintly alkaline in reaction, and contains a trace of albumin and of a copper-reducing substance. When collected from the nose it becomes mixed with mucus, and gives a faint precipitate of mucin when acetic acid is added. It is distinguished from mucus by its limpid character and the very small amount (if any) of mucin it contains, and from serum and inflammatory exudations by its low specific gravity and its containing a mere trace of albumin. If this fluid flows into the pharynx it is swallowed, and may be entirely unnoticed. In very severe fractures of the base, portions of brain matter may be forced into the nose, pharynx, or ear.

Injury to cranial nerves is shown by motor or sensory paralysis. (*See* p. 95.)

It must be borne in mind that the base of the skull may be fractured without giving rise to any symptoms by which it can be recognized. And a fracture of the base is by no means easy to detect in good stereoscopic skiagrams. The surgeon is more likely to overlook fractures that exist than to diagnose the injury wrongly when they are not present.

1. After an injury to the head or upper part of the face, an effusion of blood under the ocular conjunctiva, which may or may not spread subsequently to the eyelids (usually reaching the lower before the upper lid), indicates a *fracture of the roof of the orbit.* Hæmorrhage into the eyelids may be caused by a simple contusion (black eye), or by a fracture of the malar or upper jaw bone; in these cases subconjunctival hæmorrhage is absent, or is much less marked than the effusion into the lids. In fractures of the roof of the orbit and of the orbital arch, in which the periosteum lining the orbital cavity is not torn, the blood does not get under the conjunctiva, but only into the lids, and in such a case a diagnosis can only be made by the aid of a skiagram.

2. If, after an injury to the head or nose, hæmorrhage from the nose continues for some hours, or even for a day or more, and especially if succeeding the flow of blood there is a discharge of cerebrospinal fluid from the nose, or permanent anosmia, there is a *fracture of the roof of the nose.*

3. If, after an injury to the middle zone of the vault of the skull, or a heavy fall upon the feet or the buttocks, there is bleeding from the ear continuing for many hours, and if the blood is seen to

flow from the tympanum, there is a *fracture of the middle fossa of the base of the skull*, involving the middle ear. A copious flow of cerebro-spinal fluid from the ear is still more conclusive evidence of fracture, and shows that, in addition, the arachnoid membrane is torn. Facial palsy and unilateral deafness strengthen the diagnosis of fracture. Transient hæmorrhage may be caused by lacerations of the meatus or of the membrana tympani ; a slight flow of watery fluid might possibly be an escape of liquor Cotunnii from the inner ear ; if the fluid is richly albuminous it indicates that it is blood serum or inflammatory exudation.

4. If a patient who is known to have received an injury to the head, or may have received such an injury, after an interval vomits some dark, slightly altered blood, it becomes highly probable, in the absence of evidence to the contrary, that the blood has flowed into the pharynx from a fracture of the base of the skull, and been swallowed. The lips, mouth, and tongue should be carefully examined to exclude hæmorrhage from that source. If there is bleeding from the nose at the same time, or there are signs of such immediately after the accident and before the patient assumed the horizontal position, and if he is conscious of swallowing blood, or, when unconscious, if the movement of deglutition is seen to occur spontaneously from time to time, and especially if on inspection, or on passing the finger to the back of the mouth, blood is found in the pharynx, the diagnosis of *fracture of the base of the skull* is assured. In the absence of other evidence it will be impossible to determine which fossa is injured, as the blood may flow into the pharynx from the nose, or the ear, or from a fissure in the vault of the pharynx.

5. When, after an injury to the posterior part of the skull, or a fall upon the feet or the buttocks, a puffy swelling appears around the mastoid process, or on the side of the neck, or below the occiput, and it steadily increases in size for some hours, it indicates a *fracture of the posterior fossa of the base of the skull.*

The diagnosis is more certain when it is known that the swelling is not over the part struck.

IV. LESIONS OF THE CRANIAL CONTENTS

Intracranial lesions cause either *irritation* or *paralysis* of the nervous apparatus. **Irritation** of motor structures is shown by *muscular twitchings* or *spasms;* irritation of sensory parts causes *pain* and *hyperæsthesia;* irritation of reflex nerve-centres leads to *increased reflex* action. **Motor palsy** is estimated by noticing the position of the limbs, the absence of all resistance to passive movements, and stertorous breathing or flapping of the lips and cheeks with respiration. **Sensory palsy** is recognized by the insensibility of the patient to all external impressions, such as sound, light, pinching, pricking, and heat. **Reflex palsy** is specially indicated by a fixed condition of the pupils, and the failure of contact with the conjunctiva to cause contraction of the orbicularis palpebrarum. From these symptoms the surgeon must attempt to define the position and the nature of the lesion.

The *pulse* and *respiration* must be specially observed. Long-drawn, slow respirations indicate stimulation of the respiratory centre in the medulla, while irregular, shallow, frequent respirations—or a Cheyne-Stokes rhythm—point to its exhaustion and paralysis. Similarly a slow, full, "laboured" pulse of high tension indicates stimulation of the cardioinhibitory and vaso-motor centres, and a rapid pulse of low tension results from their exhaustion.

Position of a lesion.—(*a*) Paralysis or irritation of a single nerve, or of nerves lying close together in the skull, is probably due to some lesion of the nerve-trunk or trunks on the same side; e.g. paralysis of the fourth cranial nerve (n. trochlearis), or of the facial and auditory nerves. (*b*) When, however, the paralysis or the irritation affects nerves whose controlling cortical areas lie in close juxtaposition, it indicates a cortical lesion of the opposite side. (*c*) If the palsy affects a very wide extent of muscles, it points to a lesion of some part of the main strands of the nerve-fibres in the central nervous system passing from the cortical centres to the nerves of distribution; e.g. ordinary hemiplegia from hæmorrhage into the corpus striatum.

Electricity in diagnosis.—Although electricity is not largely used by surgeons for purposes of diagnosis, there is one way in which it may afford valuable aid in determining the position of a paralysing lesion. It depends upon the fact that, when a nerve-trunk or its centre is injured, the irritability of the paralysed muscles to the faradic current rapidly diminishes until it finally disappears, while they respond more readily to the constant current, and the anodal contraction is stronger than the kathodal. This is known as the *reaction of degeneration.* It can be observed within a few days of the onset of paralysis, and becomes more and more marked; it is always associated with rapid wasting of the affected muscles, and occurs after injury to either cranial or spinal nerves. Where, therefore, paralysed muscles do not show this reaction of degeneration, it is to be accepted as certain evidence that the lesion is situated in some part of the nervous apparatus above the nerve nucleus. This sign tells us nothing of the cause of the paralysis, only its site.

The **nature of a lesion** is indicated partly by the class of symptoms which it occasions, and partly by their time of onset. (*a*) *Irritation* is caused by slight compression, by superficial or partial laceration of the brain substance, or by inflammatory congestion; it rarely affects the cranial nerve-trunks. (*b*) *Paralysis* is caused by complete laceration of brain or nerve, by firm compression by bone, blood, or inflammatory exudation, or by shaking up of the brain with more or less appreciable contusion, or by shock. (*c*) Symptoms produced immediately by an injury are caused either by *concussion* of the brain or by *compression* by displaced bone. (*d*) Symptoms coming on within a short interval of an injury (an interval measured by hours) are due to the pressure of *effused blood or serum.* (*e*) Symptoms arising later are the result of *inflammation* or *cicatrization.*

Cerebral localization.—The **motor area** occupies the precentral or ascending frontal convolution, and a small part of the marginal convolution on the mesial surface of the hemisphere. It is divided up into several distinct centres; those for the face, the neck, the arm, the trunk, and the leg are arranged in this order from below up. The *face centre* embraces the lower end of the fissure of Rolando (sulcus centralis); its lower part, close to the fissure of Sylvius (fissura lateralis), governs the muscles of mastication and those of the larynx; the upper part controls the upper face muscles and the platysma. The *arm centre* is the largest, and occupies the middle part of the precentral convolution; the centre for the thumb extends over a great part of it; the fingers, wrist, elbow and shoulder are represented in centres which lie in this order from below up. The *leg centre* is the upper end of the precentral convolution, and extends to the mesial surface of the hemisphere ; its anterior part is concerned with movements of the thigh and leg, while its posterior part governs movements of the foot and toes. The *centre for the trunk* is intermediate between those for the arm and the leg. The *centre for eye movements* is in the second and third frontal convolutions.

Sensory areas.—The *area for general tactile sensation, temperature and muscular sense* is situated in the postcentral convolution, and the area for sensation of any particular part probably lies immediately behind the motor centre for that part. No centre for the sensation of pain has yet been found in the cerebral cortex. The *visual centre* occupies the cuneate portion of the occipital lobe and the angular and supramarginal convolutions; each occipital lobe is connected with the temporal half of the retina of the eye on the same side, and the nasal half in the eye of the opposite side. The *auditory centre* is in the superior temporo-sphenoidal gyrus, and receives impressions from each ear. The *centre for smell and taste* is in the tip of the temporo-sphenoidal lobe in the vicinity of the uncinate gyrus. There are three centres concerned with *speech*, and in a right-handed subject they are always on the left side of the brain. The *auditory word centre* is situated in the posterior part of the superior temporal convolution : its destruction causes total word-deafness. The *visual speech centre* is in the left angular gyrus : its destruction causes word-blindness or visual aphasia. The *motor speech centre* is in the posterior part of the third left frontal convolution (Broca's area) : its destruction causes motor aphasia. There seems to be a *writing centre* also on the left side of the brain, in or near the area governing movements of the hand: its destruction causes agraphia.

To **delineate these centres on the scalp,** the main thing is to fix the position of the great fissures. The *longitudinal fissure* (fissura interhemispherica) is indicated by a line drawn over the vertex from the glabella to the occipital protuberance. The upper end of the fissure of Rolando (sulcus centralis) is ½ in. behind the mid-point of this line, and it lies beneath a line 3½ in. long, drawn obliquely forwards and downwards from this point at an angle of 67° with the vertical median plane. The fissure of Sylvius (fissura lateralis), 3½ in. long, is beneath a line drawn from ¾ in. below the parietal eminence to a point 1¼ in. behind the external angular process. With these lines fixed, the centres can be filled in with sufficient accuracy for all surgical purposes.

The **primary lesions of the cranial contents** are the following:

Concussion.
Contusion and laceration.
Compression.

To arrive at a diagnosis, notice especially the time and order of the onset of the symptoms, and pay attention to the state of the patient's consciousness, to any spasm or paralysis present, to the size and irritability of the pupils, the force and frequency of the pulse, the rhythm and fullness of respiration, the presence of laryngeal stertor, or of puffing of the lips and cheeks, and the temperature and colour of the surface. The patellar reflex on each side should be carefully observed.

The symptoms of concussion of the brain vary within very wide limits—from a momentary giddiness to instant death—and, when well marked, their duration varies from hours to days. They are most intense directly after the injury, and when they are found to increase in severity it is always due to something superadded to simple concussion—generally to hæmorrhage. The following statements may be made:

1. If after an injury to the head, or a general shake of the body, the patient is temporarily unconscious, with muscular relaxation (falling down) and pallor, or if he simply feels giddy, faint, and nauseated, the symptoms are to be attributed to **concussion of the brain** in its **milder form.**

2. If immediately after such an injury a patient is found apparently quite unconscious, with complete muscular relaxation, the limbs being flaccid and motionless, and the urine and fæces passing involuntarily from relaxation of the sphincters, and the surface is pale and cold, the pulse small and soft (it is usually slow, but may be frequent), the respiration shallow and noiseless, the pupils sluggish, either unaltered in size or slightly dilated, the case is one of **severe concussion of the brain.** Except in the very gravest cases the patients show some response to a strong sensory impression: they will attempt to answer if loudly called, move away from a bright light or pungent odour, or flinch if pinched. The patellar reflex is absent in the worst cases, but when present is equal on the two sides.

3. If the state of concussion—which is usually severe and prolonged—is followed by a condition of "cerebral irritation," **contusion** of the brain with consequent diffuse or generalized œdema is to be diagnosed. Cerebral irritation is recognized by the patient lying curled up on one side, quiet when left alone, but actively or even violently resenting attempts to move or rouse him, and with perhaps a low muttering delirium at night. The pulse is full

and bounding, and the temperature somewhat raised, and, especially in children, there may be frequent vomiting.

4. Brain-matter (proved to be such by microscopical examination) may be found mixed with the blood from the wound, in the hair of the scalp, or in the nose, ear, or mouth, or lying in a wound into the orbit; this, of course, demonstrates **laceration of the brain.** It must be remembered that patients may present themselves with brain-matter thus extruded from the cranium without any symptoms to indicate so grave a lesion—without either unconsciousness or paralysis. Apart from the loss of brain-substance or of cerebro-spinal fluid, laceration of the brain may be suspected if symptoms of concussion are followed by those of irritation, and especially by convulsions of groups of muscles which leave the convulsed parts paralysed. Severe laceration is usually followed by a rise in temperature to 101° or over.

5. Whenever after an injury cerebro-spinal fluid is found escaping from the skull, it proves that there is a **laceration** of the visceral layer of the **arachnoid membrane** communicating with a fracture of the bone. When the escape of this fluid is very abundant, and particularly if it flows from a fracture of the vault, it is accepted as evidence of a *laceration* of the brain opening up one of the *ventricles.* The cerebro-spinal fluid may escape from a wound in the soft parts, or form the cystic tumour of the scalp previously described (*see* p. 73); as a complication of fractures of the base it is a very rare circumstance.

6. When after an injury to the head a patient is absolutely unconscious, it being impossible to arouse him or to make him answer questions, with fixed

dilated pupils, slow, deep, stertorous breathing with flapping of the cheeks during expiration, slow, full, laboured pulse, and paralysis, general or of one side of the body only, with exaggeration of the patellar reflex, at any rate on one side of the body—that opposite to the site of the compression—these symptoms are caused by **compression of the brain.** An attempt must be made to determine the source of the compression, and first of all *depressed bone* must be sought; and if a depressed fracture is detected, and the symptoms of compression are known to have been instantly produced, it may be regarded as the cause of the compression. If, however, the symptoms of compression have come on gradually and at a short interval after the accident (an interval during which the patient may have been quite conscious, or showing more or less evidence of brain concussion), or if while under observation it is noted that the signs of compression are increasing, the coma becoming more deep, the pupils changing from a condition of contraction to increasing dilatation, and the paralysis more extensive, it indicates *intracranial hæmorrhage.* When there has been an interval of consciousness between the injury and the oncoming of the symptoms of compression, showing that the brain has not been seriously shaken or contused; and, further, if the paralysis is or was at first unilateral, we may diagnose that the hæmorrhage has taken place between the bone and the dura mater from *rupture of a meningeal artery* or wound of a sinus. But if the symptoms point to severe immediate injury to the brain, it is probable that the blood-clot is situated on or in the brain. Symptoms of compression coming on after an interval of days or weeks from the injury, and preceded by signs of intracranial inflammation, indicate that the cause is the pressure of *inflammatory products*. (*See* p. 97.) In any case of compression the tension of the cerebrospinal fluid is raised, as shown by the rate of flow from the needle, on lumbar puncture, being greater than normal. After a fracture of the base of the skull, or when laceration or arachnoid hæmorrhage has occurred, the fluid may be stained with blood.

When the history and symptoms indicate extrameningeal hæmorrhage the surgeon *must determine on which side the clot of blood is*. Five signs will guide him. (*a*) If there is paralysis on one side only, or the paralysis is more marked on one side than the other, or the general paralysis has been preceded by unilateral spasm, the blood-clot is on the side opposite to the paralysis or spasm. (*b*) The hæmorrhage will be on the same side of the skull as the injury; and therefore if a bruise can be detected on one side, or if there is a wound, this will guide the surgeon as to the position of the clot. (*c*) If one pupil only is dilated, the clot is on the same side as the paralysed pupil. (*d*) If one patellar reflex is brisker than its fellow, the clot is on the opposite side to the brisk reflex. (*e*) If the temperature is found to be different on the two sides of the body, the clot will be found on the side opposite to the higher temperature. The symptoms of intracranial hæmorrhage are often mixed with and obscured by those of severe concussion and laceration of the brain; they are mainly characterized by paralytic phenomena. If the surgeon should trephine the skull on the supposition that there is a clot of blood between the bone and the dura mater, and on removing the piece of bone fails to find the clot, but notices that the untorn dura mater bulges up into the trephine hole, and is pulseless, and of a dark-blue colour, he may diagnose *arachnoid* *hæmorrhage*, and should make an incision into the dura mater.

7. Cases often present themselves in which there is great difficulty in determining whether the symptoms are due to the effects of **alcohol** or to a serious lesion of the brain. Whenever there is this doubt and whenever a drunken man is known to have received a severe injury to the head, he should be kept quiet for some hours until the effects of the alcohol have passed off. The signs of alcoholism upon which reliance is generally placed are the peculiar odour of the breath, the flushed face, heavy but not stertorous breathing, the contracted pupils, which dilate on arousing the patient, incoherent delirium, a tendency to become quarrelsome, tremor and unsteadiness of gait if able to walk at all, the absence of paralysis, and finding the bladder full of urine, in which alcohol may sometimes be detected. The history, where obtainable, is of course of the highest importance.

8. In other instances the question arises whether a person found insensible and paralysed has had an attack of **apoplexy,** and fallen down, or has received a serious head injury causing the paralysis. Here again there are cases in which it may be necessary to suspend judgment for a time, or even altogether. For the symptoms produced by a clot of blood in the brain are of course the same whether the rupture of the blood-vessel be spontaneous or be excited by a blow. In all such cases the age of the patient and all the attendant circumstances must be carefully noted, and the heart and the urine should be examined, as the detection of a cardiac murmur or of aortic aneurysm, or of albuminuria, would be strong corroboration of the diagnosis of apoplexy. Careful search should be made for a wound or contusion of

the scalp, depression of bone, bleeding from the nose, ear, or pharynx. A disproportion between the loss of consciousness and the paralysis, if present, would be of great assistance in the diagnosis, for in traumatic cases the sensorium, as a rule, suffers much more than the motorium, while in the idiopathic cases there may be complete hemiplegia with only very transient insensibility.

9. **Diabetic coma** may in rare cases need to be distinguished from traumatic unconsciousness. The presence of sugar in the urine, the odour of acetone in the breath, the deep coma without paralysis, the flushed face, rapid deep respirations with rapid weak pulse, will establish the diagnosis.

With regard to **lesions of cranial nerves** the following points are of practical importance:

Loss of smell is the indication of injury to the **olfactory nerve**; but care must be taken to ascertain that the nasal fossa is clear, and not obstructed by blood-clot, dried discharge, displaced bone or cartilage.

The **optic nerve** may be injured in the optic foramen by a fracture of the anterior fossa of the skull, or by a blow upon the outer wall of the orbit; the result is blindness of one eye.

Injury of the **3rd nerve** (*nervus oculo-motorius*) often affects only a part of the nerve; thus a combination of ptosis and a dilated fixed pupil is not infrequent.

The presence of ptosis, external strabismus with inability to move the globe upwards, downwards, or inwards, a fixed dilated pupil and loss of power of accommodation, so that the patient has horizontal diplopia with one clear and one blurred image, indicate complete paralysis of the 3rd nerve.

Paralysis of the superior oblique muscle causing diplopia below the horizontal meridian, and internal strabismus when the eyeball is directed downwards, may indicate a lesion of the **4th nerve** (*nervus trochlearis*), or of its centre, or interference with the play of the tendon of the muscle in its pulley; any thickening, pain, or tenderness at the seat of the pulley would render the latter the more probable diagnosis.

The **5th nerve** (*nervus trigeminus*) is rarely affected alone; when the lesion is partial the cornea rapidly sloughs unless protected.

Internal strabismus without palsy of any muscle except the external rectus points to injury of the **6th cranial nerve** (*nervus abducens*) alone.

The **7th nerve** (*nervus facialis*) is the one most frequently injured in fracture of the skull; the signs of facial palsy are unmistakable. In estimating deafness from injury to the **8th nerve** (*nervus acusticus*), reliance must be placed upon failure to appreciate sounds transmitted through the cranial bones rather than those transmitted through the auditory meatus and tympanum, as these may be obstructed by blood-clot.

The **9th, 10th,** and **11th nerves** (*nervi glosso-pharyngeus, vagus,* and *accessorius*) are rarely injured. Injury to the 9th nerve results in difficulty in swallowing and loss of taste over the back of the tongue. When the vagus is involved, in addition to dysphagia there will be dyspnœa with slow respiration, altered cardiac rhythm, and a unilateral laryngeal palsy. Injury of the spinal accessory nerve shows itself in partial paralysis of the sterno-mastoid and of the cervical part of the trapezius.

The **12th nerve** (*nervus hypoglossus*) may be injured in fractures of the posterior fossa, with deviation of the protruded tongue towards the injured side, and, later, wasting of this side of the tongue.

Secondary complications of intracranial injuries.—These complications are—

Spreading œdema of the brain.
Leptomeningitis.
Intracranial suppuration.
Hernia cerebri.
Traumatic neurasthenia.

1. When a patient recovering from the symptoms of cerebral concussion relapses into unconsciousness with rapidly increasing muscular weakness and paralysis, frequent weak pulse, high temperature, and coma fatal in a few hours, the cause of the symptoms is **spreading œdema of the brain.** The same symptoms may occur during reaction in cases of cerebral contusion, and after the removal of a large extradural clot, where the sudden relief of pressure upon the brain is followed by hyperæmia and hæmorrhage into the cortex. The rapid onset of coma in some cases of cerebral tumour is due to the same cause.

2. When after a head injury there are headache with high fever—perhaps ushered in by a rigor—vomiting, and a rapid full pulse, and these symptoms pass in a few hours into a condition of great restlessness, excitement or delirium, with intolerance cf light and sound, small pupils, optic neuritis, muscular twitchings or convulsions, and then paralysis, and these symptoms again rapidly pass into a condition of increasing drowsiness and weakness ending in coma with fixed dilated pupils, rapid feeble pulse, and irregular or Cheyne-Stokes stertorous breathing, the cause of these symptoms is **diffuse leptomeningitis or meningo-cerebritis.** The presence of retraction of the head and of intense optic neuritis, and the early occurrence of squint, point to a basal meningitis;

the early and frequent occurrence of convulsions points to a convexity meningitis, and if the convulsions are limited in area this indication is clearer. The symptoms of this disease vary greatly; those most constant are fever, headache, progressive paralysis, and coma. Examination of the eye does not show tubercles in the choroid. Lumbar puncture will demonstrate increased tension of the cerebrospinal fluid. Cytological examination of the fluid withdrawn will yield an increased cellular content or even a definite admixture of pus.

If after an injury to the vault of the skull there are persistent local pain and tenderness, **pachymeningitis** may be diagnosed; and if there is a puffy swelling of the scalp over the injured part, with signs of local compression of the cortex—localized spasms followed by paralysis—this would afford strong evidence of an abscess. The bone should be trephined, and pus may be found between it and the dura mater—**extradural abscess**; if not, and the membranes bulge into the trephine hole and show no pulsation, an incision should be made through the dura mater and the pus of a **subdural abscess** let out.

3. The symptoms of **cerebral abscess** are very ambiguous: persistent local pain, slow cerebration, increasing drowsiness, optic neuritis, subnormal temperature, and vomiting are the signs by which a cerebral abscess is usually recognized. Special paralytic effects dependent upon the exact seat and size of the abscess are also very characteristic. (*See* Chap. XXVI.)

4. When after a head injury there is fever, interrupted at irregular intervals by rigors, there is an **infective thrombosis** of one or more of the sinuses in the cerebral membranes.

5. If after a compound fracture of the skull, or

the operation of trephining, or the removal of a sequestrum from the vault of the skull, a soft mottled grey and dark-red tumour protrudes through the aperture in the bone, and, if of large size, grows in a mushroom-like form, bleeds easily when touched but is not sensitive, exhibits an expansile pulsation synchronous with the carotid pulse, and is distended by crying or coughing or any effort which increases the intracranial pressure, we have to do with a **hernia cerebri.** If on microscopical examination of a portion of the mass large irregular nerve cells are seen, it proves beyond all doubt the nature of the fungus. The history of injury to the bone preceding the appearance of the fungus at once distinguishes it from pulsating malignant tumour.

Where the hernia is of small size and slow growth a small abscess will almost certainly be found beneath it, and is its cause. But where the hernia is of large size and rapidly enlarging, it results from a diffuse lepto-meningitis.

Other and more chronic sequelæ are glycosuria, diabetes insipidus, epilepsy, dementia, loss of memory, increased susceptibility to the intoxicating effect of alcohol, and deafness, amaurosis, anosmia, etc., where there has been cranial nerve injury. A frequent condition is **traumatic neurasthenia,** characterized by headache, inability to work, giddiness, tremors, loss of emotional control, flushing of the face and head, rapid pulse, sweating, increased knee-jerks, and loss of weight.

CHAPTER VIII

DIAGNOSIS OF INJURIES OF THE SPINE

THE most serious consequence of injury of the spine is a lesion of the spinal cord or of the spinal nerves. Paralysis at a distance from the seat of injury is the great symptom of this lesion; and as in such a case any manipulation may lead to further mischief, the surgeon must first of all determine whether there is paralysis of the parts below the seat of injury. If there is none, he then examines the bones of the spine, and after that the muscles and ligaments.

I. **Injuries of the spinal cord and nerves** are indicated by paralysis, and sometimes by signs of irritation. Two points must be specially noted—the **extent of the paralysis,** and the **time and mode of its onset.** By the first we can determine the seat of the lesion, and from the second we can generally infer its nature and cause. Sensation to touch, to pain, and to heat should be carefully tested, and all anæsthetic areas marked out. The power of voluntary motion must be tested. Areas of hyperæsthesia, muscular spasm or rigidity, and pain must be carefully noted. Then the various reflexes (the superficial, the deep, and the visceral) must be tested.

1. Anæsthesia or motor palsy corresponding to the distribution of a particular nerve indicates a lesion of that nerve.

2. Paralysis below a certain horizontal plane

indicates a lesion of the spinal cord at a corresponding level.

3. If with complete paralysis there is also complete anæsthesia to touch, pain, heat and cold, and the reflexes in the paralysed area are entirely lost, it indicates that there is a complete transverse lesion of the cord.

4 But if with complete paralysis and loss of reflexes the anæsthesia is not complete, the lesion is not a total transverse one. Traces of muscular power, and the presence of reflexes either very slight or exaggerated, are further signs of the incompleteness of the lesion.

5. Recovery of reflexes soon after the injury shows that the temporary loss was the result of shock or of spinal concussion.

6. Paralysis observed immediately after the injury is due to compression, bruising, or actual crushing of the cord by displaced bone or a foreign body, or to hæmorrhage into the cord.

7. Paralysis coming on very quickly after an injury, and rapidly extending upwards, is due to meningeal hæmorrhage—*hœmatorrhachis.* The paralysis is generally incomplete and accompanied by severe pain.

8. Paralysis of the arms only, with contracted pupil and rapid wasting of the paralysed muscles, indicates hæmorrhage into the cervical enlargement of the cord—*hœmatomyelia.* The paralysis comes on very quickly after the injury.

9. Pain shooting round the trunk and down the limbs, spasmodic contraction of muscles, and exaggerated reflexes are the signs of meningeal irritation. If present immediately after an injury they point to irritation by fragments of bone or by blood ; coming on later they are due to *meningitis.*

10. Rapidly increasing paralysis, loss of reflex excitability, wasting of muscles, coldness, and other trophic changes are signs of progressive destruction of the spinal nerve centres caused by *myelitis*. The myelitis may extend upwards or downwards from a crush of the cord.

The observer's knowledge of anatomy will enable him to fix the seat of the lesion in the spinal cord by the extent of the paralysis; but a few leading points may be here cited. (*a*) Below the 1st lumbar vertebra (sometimes 12th dorsal or 2nd lumbar) the spinal canal contains only the nerves of the *cauda equina*. (*b*) If there is complete motor and sensory palsy of the lower limbs, with loss of sensation as high as the umbilicus, it indicates a lesion of the cord at the level of the 9th *dorsal vertebra* or opposite the roots of the 10th *dorsal nerve*. (*c*) If, however, the palsy involves the muscles of the belly wall and the intercostal muscles, and the anæsthesia extends up to about the 2nd rib, and involves also an area on the inner and back part of the skin of the arm, it indicates a lesion of the cord opposite the 1st *dorsal vertebra*. (*d*) If the palsy involves also the upper limbs, sensation being perfect over the head, face, neck, and just below the shoulder and clavicle, and the respiration is solely diaphragmatic, it points to a lesion opposite to, or but very slightly above, the 5th *cervical vertebra*.

By noting the state of the *reflexes* very important information is obtained. A reflex may be lost by interruption of its afferent or efferent path, or by paralysis of its centre. When, then, it has been determined that there is a lesion of the cord at a particular level, and there is no evidence of injury to the nerves below, the condition of the reflexes whose centre is in the part of the cord below this level will indicate the functional state of that part of the cord. For example, in a case of crush of the spinal cord by a fracture-dislocation of the 5th cervical vertebra from a fall on the head, if we find that the plantar, patellar, cremasteric, anal, vesical, gluteal, abdominal, and epigastric reflexes are preserved, it will indicate that the cord below the lesion is functionally active, and that the damage to the cord is not great.

It must be remembered that, immediately after such an injury as we have supposed, the spinal cord below will be temporarily paralysed by "concussion"; but this should pass off in a few hours, and if after this interval the reflexes cannot be obtained, the damage is certainly serious, the lesion being possibly though not necessarily a complete transverse one. This same symptom may of course be used to detect the functional condition of the cord above as well as below the lesion.

In estimating the reflexes in these circumstances the observer must bear in mind the simple physiological effect of shutting off all volition. For instance, when the finger is passed within the anus of a healthy man, the sphincter contracts by a simple reflex stimulus, much strengthened by a strong voluntary effort, and therefore, in a crush of the cervical cord where all voluntary effort acting upon the rectum is shut off, the anal contraction will be much slower and more feeble, even if the reflex action is perfect. Similarly in micturition: when the bladder is full a stimulus is conveyed up to the micturition centre in the lumbar enlargement of the cord, which is reflected along motor nerves to the detrusor urinæ muscle; but volition also comes into play, and brings other muscles into action, notably those of the abdomen, and sometimes many of those of respiration. Micturition so performed is a quick and powerful expulsive effort; but if the voluntary part is shut off, the mere reflex act is in comparison slow and feeble.

Certain paralytic phenomena demand fuller consideration; we shall notice those which are constantly coming under observation.

Incontinence of urine.—When the centre in the lumbar enlargement of the cord and the 3rd and 4th sacral nerves are intact, but the path of sensory and motor impressions along the cord above is injured, there will be at first retention of urine during the condition of shock or concussion, and when this passes off there will be reflex discharges of urine of which the patient will be entirely unconscious. Should only the motor impulses be affected the patient will be conscious of the passage of urine but quite unable to influence it, while if only the sensory impulses fail he will, in the absence of sensation, make no voluntary effort either to restrain or to assist the reflex emptying of the bladder. But if the centre in the cord, or the nerves passing between it and the bladder, are the seat of the lesion, all reflex action is abolished, periodical discharges of urine do not take place, but true incontinence of urine, gradually becoming absolute, is established: the urine then trickles out of the urethra as constantly as it trickles into the bladder; a little lodges in that viscus under the action of gravity, or is retained by the resistance to its discharge offered by the long and doubly curved urethra.

Priapism is the name given to the condition of erection of the penis frequently observed in spinal injuries. It may be extreme even to the point of extravasation of blood, but is more often partial and incomplete. It is a sign that the erection centre in the lower part of the spinal cord is cut off by some intercepting lesion from the inhibiting influence of the higher centres. It is not usually met with in crushes of the lower part of the cord, but in those of the cervical and upper dorsal regions. The occurrence of a true erection is stated to be evidence of the incompleteness of the cord lesion.

Incontinence of fæces.—The centre governing the contraction of the sphincter ani is situated in the lumbar enlargement of the cord, and if it and the nerve paths between it and the rectum are intact, the presence of the finger in the anus or of fæces in the rectum will cause reflex contraction of the sphincter. If the cord is crushed above this centre, when the pressure of the fæces becomes increased beyond a certain point, or at an earlier period if they are fluid, the sphincter yields, and a discharge takes place unknown to the patient. This is not true "incontinence of fæces," but merely "*involuntary and unperceived discharge of fæces*," and the act will be repeated only at distinct and even long intervals. Where the lumbar enlargement of the cord or the cauda equina is crushed, the sphincter ani does not respond to the presence of the finger within that aperture, or of fæces in the rectum, and the expulsion of the latter by peristaltic action is unopposed; as, however, except in the condition of diarrhœa, fæcal matter passes into the rectum only occasionally, we have here again, as a rule, an "involuntary and unperceived discharge of fæces," which becomes, when the evacuations are loose, a true incontinence of fæces.

The student will notice that the distinction between these two conditions, or between the effects of lesion of two parts of the spinal cord, is to be made out by the finger introduced within the anus, and not by noticing the discharge of fæces. In connexion with this subject it may be pointed out that the flatulent distension and very obstinate constipation which are frequently observed in cases of crush of the upper dorsal or lower cervical spinal cord, while partly due to paralysis of the abdominal muscles, are probably to an important degree dependent upon damage to centres in the spinal cord which regulate the peristalsis of the various sections of the alimentary canal.

Bedsores and **alterations in the urine** may be mentioned together, as each is attributable to two classes of causes. Bedsores coming on after some days are due to the effects of pressure, friction, or the irritation of urine or fæces upon the paralysed parts, and they can be obviated by careful nursing. But in other cases large and deep bedsores form quite early (within two or three days) where such causes can be excluded, and these are to be attributed to irritative lesions of the spinal cord; but whether they are due to vaso-motor changes, or to injury to special "trophic" centres, or are to be ascribed to unusual impulses passing along the nerves, is not known. Similarly, the changes in the urine, its alkalinity, decomposition, turbidity, and admixture with muco-pus, may be attributed to decomposition of the urine started by and dependent upon micro-organisms introduced by the catheter passed to relieve the retention; and where care is taken to exclude this accident by aseptic catheterism, such decomposition of the urine can be obviated. But in other cases, in spite of all such precautions, and at an early period after the spinal lesion, nephrocystitis is set up, with decomposition of the urine, hæmorrhage and sloughing of the bladder, and sometimes of the urethra; this is to be regarded as a trophic effect.

As in the case of the brain, injuries of the spinal cord may be attended with symptoms of **irritation** as well as of paralysis. These are *pain*, *hyperæsthesia*, *muscular spasm*, and *excessive reflex irritability*. Where these symptoms occur at and from the time of the injury, they indicate some irritation caused directly by the injury; this may be meningeal hæmorrhage, but it is more often some displacement of bone, or the presence of a foreign body, causing pressure upon a nerve in the intervertebral foramen. Coming on at a late period, these symptoms point to inflammatory irritation; they are more marked in *meningitis* than in *myelitis*, which quickly ends in paralysis.

II. **Injuries of the vertebræ.**—It must not be forgotten that some cases of sudden death from injury are due to crush of the upper part of the cervical spinal cord from fracture-dislocation of the bones, and, when an explanation of the death is not elsewhere found, this region should be carefully explored. Very free mobility of the head, with or without crepitus, will point to this injury.

Where the symptoms of paralysis come on immediately upon the receipt of an injury to the spine and indicate a crush of the spinal cord, a **fracture-dislocation** of the bones opposite the injury to the cord may be inferred. If the lesion is in the cervical or dorsal region a thorough examination of the spine, except by taking a skiagram, will not be justifiable, as the injury of the bone is unimportant compared with that of the spinal marrow, and the manipulations requisite to determine the state of the bones are attended with the danger of rendering the crush of the cord more extensive, and of exciting myelitis, which, spreading up, will cause further, and possibly fatal, paralysis. When, however, the injury is in the lumbar or sacral region a careful examination of the spine should be made, for there we have the resistant cauda equina occupying the spinal canal; if any displacement of the bones is detected it will be justifiable to attempt its correction. In such a case, then, the patient should be carefully turned on to his side, or even his face, and the surgeon should pass his fingers steadily down the vertebral spines to determine whether there is or is not any break or dip in their line; and if a marked deformity is detected, efforts should be made to replace the bones. It must be borne in mind that regularity of the line of the spines is no proof of the absence of fracture-dislocation in the face of evidence of crush of the cord or nerves, for the displacement of the bones may have been but momentary, or reduced by subsequent movements.

In cases, however, in which there is no evidence of crush of cord, but where a severe blow has been received on the spine, the examination may be made more deliberately. The patient standing up, the surgeon should examine the lines of the spines and transverse processes to determine whether there is any irregularity, depression, or marked lateral deviation at the injured part, and, seizing the spinous processes between fingers and thumb, he should attempt to move each of them laterally to determine whether any one of them is detached. A skiagram should certainly be obtained, to add to or confirm the clinical findings.

It is in cases of injury to the cervical spine, and especially to the higher part of it, that the examination becomes most critical. Where the cord is crushed the symptoms are unequivocal; but where there is, or is suspected to be, a fracture or a dislocation without crushing of the cord, the examination must be made with the utmost care lest further displacement should occur with crushing of the cord, and sudden death or rapidly fatal paralysis. Such cases, then, are only to be investigated with the utmost gentleness; pain and rigidity are the symptoms suggesting such an injury, and where the face is turned to one side and fixed in that position it points very strongly to dislocation forwards of a cervical vertebra on the opposite side. A skiagram is the safest and most certain means of recognizing such a fracture in the cervical spine. Later on, when ankylosis is obtained, the parts may be freely examined, and irregularity of the spines and transverse processes, with perhaps thickening from masses of callus, may confirm the previous diagnosis of a fracture.

Fracture and dislocation of the coccyx may be produced by direct violence, such as falls and kicks, and possibly also in parturition. Any act in which the muscles attached to the injured coccyx come into play, such as walking, coughing, and defæcation, causes great pain. On examining the part externally, irregularity or crepitus may be detected; but if not, the finger should be passed into the rectum and the anterior surface of the bone explored. If a part of the bone is found movable upon the rest, with crepitus, it shows that the bone is fractured; while, if a marked transverse projection at the base of the bone is felt, it indicates a dislocation. It must then be noted whether the prominence is the lower end of the sacrum or the upper end of the coccyx, and this will decide whether the coccyx is dislocated backwards or forwards.

III. **Injuries of the ligaments and muscles** are often combined with the more serious lesions we have been considering above; but they occur not infrequently quite apart from them, as a result of sudden and violent twists, blows, and strains of the spine. They are the cause of pain and of a certain amount of rigidity of the spine, which often lasts for some time, especially in the case of railway accidents and other severe contusions.

Immediately after the accident the symptoms are localized pain and tenderness, with pain on attempting to move the injured part of the spine, and often some swelling and ecchymosis; there is neither irregularity nor mobility of the spines or transverse processes. There is no paralysis or hyperæsthesia of distant parts, unless there is also some lesion of the spinal medulla or nerves. It is, however, later on, when the first effects of the injury have been recovered from, and the pain continues, that the diagnosis becomes of most importance, and the surgeon has to determine whether there is a simple sprain of the muscles and ligaments of the spine, or disease of the bodies of the vertebræ, or chronic meningo-myelitis.

In any case where an action for damages is pending, the examination must be made with the utmost care and circumspection, as the patient may in these circumstances be self-deceived, or may be malingering. The general appearance and behaviour of the patient should be carefully noticed, as well as his movements while his attention is diverted into some other channel.

A good skiagram is useful to detect or exclude a fracture or displacement of a vertebra, as well as possible destruction of bone tissue by tubercle, sarcoma, or carcinoma.

In the absence of muscular spasm or paralysis, hyperæsthesia, paræsthesia, or anæsthesia at a distance from the injured part, and of increased or diminished reflexes, *meningo-myelitis* may be excluded. If the pain has continued for many months and there is no projection of a spine or spines (angular kyphosis), and if there is a certain amount of movement of the vertebræ one on another, while pressure down the spine from the head or the shoulders does not excite severe pain, *caries of the spine* may be excluded (*see* Chap. XXVIII.). It must be remembered that spinal caries may be set up by a sprain. If, in the absence of these signs, there is a localized pain in the back, made worse by movement, with some tenderness along the spines, or of the muscles by the side of them, and limitation of movement owing to pain, a **sprain of the spine** may be diagnosed. Exaggeration of the superficial and deep reflexes may be associated with this condition.

If the muscles are found wasted, and the spine can be bent painlessly to a moderate degree, while the effort to straighten it causes pain referred to the attachments of the erector spinæ, the injury is mainly confined to that muscle. If, on the other hand, the muscles are found fairly well nourished, and the pain on moving the spine is not in straightening it, but in bending it beyond a certain slight extent, it points to sprain of the vertebral ligaments. A **muscular sprain** is recognized by the pain caused by the contraction of the muscle; a **ligamentous sprain** is characterized by the pain on stretching the ligament; it must, however, be noted that pain is caused when a sprained muscle is stretched to the full. Occasionally, after severe sprains of the spine, especially of the neck, as in other joints, the part is left too movable, the ligaments being loose and lengthened. A severe wrench of the spine without fracture or dislocation may be followed by hæmorrhage around the cord, or by suppuration in the spinal canal, suppurative meningitis, or acute osteomyelitis of the spine.

IV. **Wounds of the spine.**—Mere skin or flesh wounds of this region have no special feature. If, however, a deep wound, such as a stab, is attended with a free flow of a clear watery fluid, it shows that the **theca vertebralis** is injured and that the subarachnoid cavity is opened. Such an injury, if infected, will be followed by *acute meningitis*.

If a wound of the spine is immediately followed by paralysis of sensation or motion, it shows that the spinal cord, or one or more of the spinal nerves, is injured. The distribution of the paralysis will enable the observer to determine the position of the nerve lesion. Division of a nerve causes paralysis of the parts supplied by that nerve, without any effect upon the parts below; division of any part of the spinal cord paralyses all the parts below in those functions for which that particular section of the cord is a conductor.

In the case of a gunshot injury, an X-ray plate will reveal the presence and position of the foreign body if retained, and of displaced fragments of bone. The question whether and when to operate in such a case may depend upon the degree and site of injury inflicted upon the cord or nerves, and in the former case upon whether there is complete transverse division or not; and special importance attaches, therefore, to an accurate diagnosis upon the lines given above.

Wound of the spinal cord may be followed by *myelitis*.

CHAPTER IX

DIAGNOSIS OF INJURIES OF THE FACE

The greater number of the injuries of the face are too obvious in their nature to require notice here; but it may be pointed out that wounds must always be carefully examined for foreign bodies, that bruises must be examined for signs of fracture of the subjacent bone, and that the swelling following laceration of tissue is often more marked in the face, particularly the lips and eyelids, than in other regions. When from a wound of the cheek there is a great flow of a watery fluid during mastication, the fluid being alkaline in reaction, and amylolytic, it indicates a wound of the **parotid gland** or of **Stenson's duct (ductus paroticus).** And if, when the rest of the wound heals up, a sinus remains which continues to discharge saliva, it is called a **salivary fistula.** The alkaline reaction of the fluid, and its intermittent flow, which is always excited by mastication, are usually alone relied upon to decide the nature of the fluid; but if, on adding some of the fluid to a small quantity of a watery decoction of starch, and maintaining it at a temperature of about 100° F. for an hour, it is found that the addition of a drop of tincture of iodine fails to give the characteristic deep-blue reaction, and that a brown colour is produced, or no effect at all, the diagnosis is rendered certain. If the wound or the fistula is behind the middle of the masseter muscle, the saliva is escaping from the parotid gland; but if in front of that line, it must be the duct which is wounded.

If, in addition to an ordinary bruise of the face, such as a "black eye," there is a distinct swelling, circumscribed, prominent, fluctuating, and dull on percussion, it is a **hæmatoma.** Such a swelling may become solid from coagulation of the blood, or may suppurate.

If immediately after a blow upon the nose a smooth, tense, rounded, glossy, purple swelling is found blocking up one nasal fossa and fixed to the septum of the nose, it is a **hæmatoma of the nasal septum.**

If after a blow upon the face there is a puffy swelling, soft, crackling under the fingers, and resonant on gentle percussion, it is due to **emphysema,** and indicates a fracture extending into one of the air-containing cavities of the face. The position of the earliest swelling will indicate whether the fracture is into the frontal sinus, the nose, or the antrum.

For the detection of **fractures of the facial bones,** each bone should be carefully examined to determine whether there is any marked deformity, abnormal mobility, or crepitus. This examination is easily carried out unless there is much swelling of the soft parts. In cases of difficulty a good *skiagram* will be of great service. Run the forefinger along the bridge of the nose to see if there is any sharp break in it; then, in the same manner, with the two forefingers examine the sides of the nasal bones and the nasal processes of the superior maxillæ. To deformity may be added mobility and crepitus, and in that case there can be no doubt in the diagnosis; the point or line of deformity and mobility will determine the position of the fracture. Then examine the upper row of teeth and the alveolar process, see if its line is broken, and if any part of it can be moved; with the eye and finger examine the hard palate to determine if it is regular and symmetrical, and that the two halves are not separated. Then throw back the patient's head and, gently everting the nostril, examine the septum nasi on each side; it may be found fractured and displaced vertically or laterally, with depression of the tip of the nose. But care must be taken not to mistake a natural deflection of the septum for a fracture in it; when the mucous membrane over the septum is unaltered in colour and not swollen, the curvature not tender, and there is no unwonted obstruction to the passage of air along the nose, it may be considered a natural deflection of the septum; but when, on the other hand, the curvature is abrupt, the part swollen, discoloured, and tender, and there is unwonted obstruction to nasal respiration, along with flattening or deflection of the nose, it must be regarded as a fracture. Then compare the two malar bones and note any irregularity, flattening, or mobility of the one struck; and from these pass the fingers back along the zygomatic arches to determine whether either is broken across, which will be indicated by irregularity of the bone and mobility of the fragment. In some cases of fracture of the bones of the face the fragments move with the utmost ease, in others they are impacted; in other cases again there is so much swelling and bruising of the soft parts that the characteristic bony deformity is only detected when this has cleared up, and early diagnosis in such cases can only be made with certainty by good stereoscopic skiagrams.

The **lower jaw** must be examined in a similar manner. The surgeon should first run his fingers along the outer and under surfaces of the body of the bone to detect any irregularity or want of symmetry of the two sides. Then let him look at the line of the teeth, and, if any irregularity in it is seen, let him grasp the bone, with one hand on each side of the deformity, and try whether there are mobility and crepitus, and note whether the fracture extends through the alveolar process alone or through the body of the bone as well. If the fracture is opposite to or behind the canine tooth, the sensibility of the lower lip on the same side should be tested, to ascertain whether there is also injury of the inferior dental nerve. The surgeon should carefully note whether all the teeth are in place, and if not he should make sure that one has not slipped down between the fragments. The ramus of the bone must then be carefully examined: by seizing the angle mobility can be tried for; the contour of the posterior border as well as of the surface should be felt through the masseter muscle. Should these parts be sound and yet the patient complains of great pain in opening and closing the mouth, while he can himself feel and hear crepitus, the coronoid and articular processes should be carefully examined. Place the forefingers, one immediately in front of each pinna, to feel the condyles in their normal position, carefully compare them to make certain whether they are or are not symmetrical, and look closely at the position of the chin, noting whether the space between the lower central incisor teeth is vertically below that between the upper; should there be deformity of one condyle, while the chin is displaced to the same side, a fracture of the neck of the jaw on that side is to be diagnosed. The coronoid process is to be explored by the finger in the mouth, which may detect that it is movable on the rest of the bone, and sometimes a sharp projecting edge or point of the fracture can be felt.

If, however, on placing the finger immediately in front of the tragus, the firm, slightly projecting condyle of the lower jaw is not to be detected, but, on the contrary, a hollow (the glenoid fossa) is felt, while there is a fullness of the temporal fossa just above the zygoma, there is a **dislocation of the jaw.** This may be *unilateral*, in which case the chin is displaced to the opposite side, or *bilateral*, when the mouth will be open and the chin protruded.

CHAPTER X

DIAGNOSIS OF INJURIES OF THE NECK

The injuries of this region may be divided into wounds, contusions, the impaction of foreign bodies in the respiratory or alimentary passages, and the local effects of heat and caustics. Sprains and fracture and dislocation of the cervical spine have been considered under the head of Injuries of the Spine. (Chap. VIII.)

Wounds of the neck, inflicted from the outside, are, of course, obvious, but they vary from the most trivial, through all grades up to those which are almost instantly fatal, and it is necessary, for purposes both of prognosis and of treatment, to determine what parts have been severed. The questions of primary interest are (i) wounds of vessels and hæmorrhage, and here the ordinary rules will guide the surgeon, and (ii) wounds of the air-passages. The main vessels lie so deeply that they are comparatively rarely severed. If the wound is in front above the hyoid bone, the *tongue* may be implicated. An incision in the thyro-hyoid space may sever the *epiglottis*, and so open into the *pharynx*. Wounds opposite the thyroid cartilage, and severing that structure, may traverse the larynx above, at the level of or below the *rima glottidis*. Still lower down, the *crico-thyroid membrane*, or the *trachea*, may be implicated. A wound of the *air-passage* will be shown by the escape of air from the wound, and oftentimes also by the escape of mucus and frothy blood, and by the loss of voice. If the trachea be cut completely across, urgent or even immediately fatal dyspnœa may result from displacement of the lower portion backwards. Less urgent respiratory embarrassment is caused by free bleeding into the lumen of the trachea. The *pharynx* is readily opened through the thyro-hyoid space; but below that, it and the gullet can only be injured by a wound on the front of the neck that has first completely severed the larynx or trachea. Where the wound is thus very deep it may in some instances be obvious that the alimentary canal is opened or severed; but where there is doubt it should be cleared up by passing a soft catheter or œsophageal tube through the mouth and noticing whether it is visible through the wound. The surgeon should not give the patient food to swallow to see if it escapes through the wound in the neck, as it may pass into the air-passages and do serious harm.

In cases of **gunshot wound** or of **stab** in the neck, where the injured parts cannot be so well and so easily explored, the diagnosis has to be more largely inferential. If a soft, puffy, crackling swelling forms, which increases on attempts at coughing, it is evidently subcutaneous emphysema from *wound of the air-passage*; such a wound is also to be diagnosed if the patient coughs up frothy blood. A stab or gunshot *wound of the œsophagus* (*gula*) may pass unnoticed; but if the patient vomits blood, or if deglutition is very difficult or painful, and especially if on drinking milk some of the fluid appears at the external wound, such an injury is to be diagnosed. *Injury of the carotid arteries*, apart from wounds resulting in hæmorrhage so severe as to be rapidly fatal, may be followed after some interval by the appearance of a traumatic aneurysm. The signs of an arterio-venous aneurysm so produced appear at once. *Injury of the nerves* of the neck will be shown by limited paralysis; in the posterior triangle the great cords of the *brachial plexus* may be severed, and there will then be motor and sensory paralysis of parts of the upper limb; or the *phrenic* nerve may be injured as it lies on the scalenus anticus: this will be shown by paralysis of the diaphragm, causing difficulty in taking a full inspiration, and inability to force down the abdominal viscera, and protrude the belly-wall fully on the same side. If, after such a wound in the neck, the pulse is found irregular and quick, and the action of the heart turbulent, it points to injury of the *vagus* nerve; while if the pupil on the same side is small, and does not dilate when both eyes are shaded, it indicates an injury of the *cervical sympathetic.* If the wound is high up in the neck and there is paralysis of the same side of the tongue with rapid wasting, there is injury to the *hypoglossal* nerve. If there is loss of voice or dyspnœa, not otherwise explained, the larynx should be carefully examined with a laryngoscope, and if one of the cords is found in the cadaveric position, and unmoved when the patient attempts phonation or takes a deep inspiration, paralysis of the muscles of that side of the larynx from division of the *recurrent laryngeal* nerve must be diagnosed. In the case of bullet or shell wounds a skiagram to demonstrate the presence and exact position of a lodged bullet or piece of shell-casing is all-important.

In regard to **wounds inflicted from the inside,** it only needs to be pointed out that an exact diagnosis may be quite impossible; hæmorrhage may show that a vessel has been wounded, but there may be nothing to indicate what particular vessel is injured, especially where the wound is out of sight.

Contusions of the neck may be instantly fatal. Where this is not the case the examination should be conducted with the view of determining whether the *hyoid bone* or any of the cartilages of the *larynx* or the *trachea* have been injured. The arch of the hyoid bone should first be examined to see if there is any irregularity in it, or whether on compressing the two cornua crepitus is obtained, or great pain caused, or whether the bone yields with the normal elasticity. Where the bone is broken there is usually great pain in deglutition and in any movement of the tongue, so that speech is difficult and painful there is also inability to turn the head, and on looking into the mouth ecchymosis of the mucous membrane may be observed. Dislocation of the hyoid bone, in which the cornu of the bone catches against the cornu of the thyroid cartilage, has been described.

Next examine the *cartilages of the larynx*, especially at and near the posterior superior cornua of the thyroid cartilage, where fracture is more common than has been supposed; it is indicated by want of symmetry and by mobility of the fragment; crepitus may be felt. There may be so much swelling from effused blood or from emphysema that no precise diagnosis may be possible. The symptoms may be nil or very severe—dyspnœa, cough, and pain.

The *trachea* is very rarely ruptured; but if after a blow on the lower part of the front of the neck there are severe dyspnœa, a cold, livid countenance, weak or lost voice, and emphysema of the neck, and the larynx can be felt to be normal, this injury may be suspected, and the diagnosis will be established by noticing a gap in the trachea, if the state of the patient permits digital examination.

CHAPTER XI

DIAGNOSIS OF FOREIGN BODIES IN THE PHARYNX, ŒSOPHAGUS, AND AIR-PASSAGES

Cases in which foreign bodies have passed from the mouth, and in some instances from the stomach, into the gullet or air-passages, are very serious and often present great difficulties in diagnosis. There may be a distinct history pointing to such an accident, but if there is no such history and the surgeon has to trust alone to the results of his examination the cases are very obscure.

The **history** that may be volunteered, or that should be inquired for, is that of a sudden inspiration or effort while food or some other substance was in the mouth or held between the lips, of vomiting, or of hurried swallowing of only partially masticated food, etc., followed immediately by symptoms of obstruction to respiration, to deglutition, or to both. In young children there may be an entire absence of history, or it may be known only that the child had something in its mouth when the symptoms suddenly supervened; and if it be cherries or plums that the child was eating, the fact becomes additionally significant. In older persons the symptoms may come on during sleep, from the slipping of a plate of artificial teeth, and the surgeon in any case of sudden symptoms of obstruction should satisfy himself that this accident has not happened. In vomiting during unconsciousness from alcohol, chloroform, etc., some of the vomited matters may pass into the air-passages. A history of the inhalation or swallowing of a foreign body should never be disregarded.

The **symptoms** vary greatly with the position, size, and nature of the foreign body; they may be so severe as to threaten or cause sudden death, or so slight and ambiguous as to be altogether overlooked. In addition to those more or less directly resulting from the impaction of a foreign body, there are those due to the secondary inflammatory changes set up; these may be either acute or very chronic. The chief primary symptoms are pain and difficulty in deglutition, pain and difficulty in respiration, spasmodic cough, loss or change of voice, and obstruction to the entrance of air into a part or the whole of one lung. The abrupt onset of these symptoms and the absence of the other usual phenomena of disease, such as fever, are very characteristic. The secondary symptoms are those of suppuration about the pharynx or gullet, or of suppuration in one lung, with dilated bronchi.

The diagnosis.—In cases of extreme urgency, with sudden dyspnœa threatening life, the surgeon will at once thrust his finger to the back of the mouth to feel for and to dislodge any body that may be over or in the upper orifice of the larynx, and, failing this, will proceed to open the larynx or trachea, without waiting to make an exact diagnosis of the cause and actual position of the obstruction.

In cases of less urgency the examination is made with more deliberation and care.

Foreign bodies in pharynx or œsophagus.—The usual mode of procedure was for the surgeon to pass his right forefinger into the pharynx, and with it to explore the fauces, tonsils, upper orifice of larynx, and as far down the pharynx as he could reach; in many cases this would suffice to determine the presence and position of a foreign body, and even to dislodge it. But it was at the best a rough method, and it gave no information about foreign bodies that had passed through the rima glottidis or into the gullet. Œsophageal bougies and probangs may enable the surgeon to detect resistant and firmly impacted foreign bodies of some size, but they give no information about the (often penetrating and very dangerous) smaller ones. Large bodies, such as a plate of false teeth, if impacted in the gullet in the neck, may be felt through the neck, especially if the head is bent forwards and the fingers are passed beneath the relaxed sterno-mastoid muscle.

Whenever possible the diagnosis is to be made by sight, and the exact nature, position, and relations of the foreign body identified. We have two means of doing this: by the Röntgen rays we can obtain a picture of coins and other metallic foreign bodies; and by the laryngoscope, bronchoscope, and œsophagoscope we can see foreign bodies of any kind, whether in the pharynx, gullet, larynx, trachea, or main bronchi.

It is usually easy to determine whether the foreign body is lodged in the air-passages or in the food-passage: dyspnœa and cough indicate the one, dysphagia the other. If the patient can drink off a glass of water *quickly* and can swallow bread *readily* it may be accepted that the pharynx and œsophagus are free. By throwing a strong light from a brow mirror or electric lamp into the mouth, that cavity and the fauces and central region of the pharynx can be well explored. With the laryngoscope the larynx can be examined, and where that is found free, and the symptoms point to the air-passages as the seat of the mischief, an anæsthetic should be administered and the bronchoscope carefully passed into the trachea and, if necessary, into each bronchus. Should the food-passage be suspected, the œsophagoscope is passed slowly and carefully, and by this means the lower end of the pharynx and the whole length of the gullet can be well seen. The naso-pharynx can be explored by posterior rhinoscopy and by the finger passed behind the soft palate.

Although we are now able to see foreign bodies by one or both of the methods mentioned, there are certain facts about this branch of surgical diagnosis that it is well still to point out.

In vomiting, foreign bodies are sometimes forced into the **naso-pharynx**—a tooth-plate has been known to be dislodged from the mouth, pass into the pharynx, and then to be impacted behind the soft palate. This region can be explored by posterior rhinoscopy and by the finger.

A scratch or abrasion made by a sharp substance on its way to the stomach often feels to the patient as if something were actually pricking his **gullet** every time he swallows. Having satisfied himself by careful inspection that no foreign body is present, the surgeon may be assured that time will support his diagnosis, for if it is an abrasion or wound of the gullet, and if only soft food is taken and is swallowed carefully, the pain will gradually subside; whereas if a foreign body is impacted, the pain will continue, and the patient may hawk up a little blood and pus.

If the symptoms lead to the belief that there is or may be a foreign body in the **air-passages**, the case becomes one of grave importance, demanding a most careful examination. It must be remembered that while such an accident may induce the most distressing and alarming or even quickly fatal symptoms, in other cases the symptoms are very slight, and further, that, having been severe at first, they may quickly subside and give the impression that the foreign body has been expelled : this latency of symptoms must not deceive the surgeon. Where a foreign body completely blocks one of the main bronchi, e.g. a plum-stone in the right bronchus, the physical examination of the chest gives very characteristic signs. The right side of the chest will make no respiratory movements ; it will be resonant on percussion, and there will be an absence of breath-sounds, unless there be a sibilant rhonchus heard over the bronchus and due to incomplete plugging of the bronchus. The lung on the unaffected side will be hyper-resonant ; its respiratory movements and sounds will be exaggerated. It should be remembered that in such cases there may be no dyspnœa or distress while the patient is quiet. Should an absence of breath-sounds or a loud sonorous or sibilant râle be detected over a part of one lung, the symptoms may be attributed to the impaction of a foreign body in one of the secondary or tertiary bronchial tubes. In some cases a diagnosis has only been possible when the foreign body has been actually extruded either through the mouth or through an abscess in the chest walls.

Cases where foreign bodies have lodged for some time, and have set up suppuration, bronchiectasis, and pulmonary fibrosis, are liable to be overlooked unless the history of the onset of the affection is elicited. Unusual localization or exact limitation of the physical signs, however, should always suggest inquiry as to the possibility of the cause being an impacted foreign body. The lung may be explored for a foreign body by the finger passed into the pleural sac.

There are other cases of injury from foreign bodies getting into the air-passages or gullet, viz. those due to hot liquids or caustics. In such cases the lips, mouth, and tongue may or may not show signs of scalding, or of the caustic effects of acids or alkalis. In some instances the rapid onset of laryngeal obstruction in a child who has shown no previous symptoms is the first and only evidence of scald of the larynx.

CHAPTER XII

DIAGNOSIS OF INJURIES OF THE CHEST

INJURIES of the chest are of very frequent occurrence, and from the great importance of the contained viscera they are of especial practical interest. They may be classified into *contusions* and *wounds*; and as the sequelæ of the two groups of injuries are to some extent the same, only the immediate and direct effects of contusions and wounds will be considered at first, and in a concluding section of the chapter the diagnosis of all the sequelæ or secondary complications of chest injuries will be given. Many of these latter are inflammatory affections which, when idiopathic, come under the care of the physician, and much fuller information concerning their diagnosis will be found in works on Medicine.

I. CONTUSIONS

A patient having received a contusion of the chest, the diagnosis may be best arrived at by the surgeon's attempting to answer the following five questions:

1. **Is there a bruise?**—The presence or absence of the well-known ecchymotic discoloration will decide this point. If a purple or yellowish stain appears in the skin after an interval of a few days, it indicates a deep bruise; ecchymosis of the skin of the loins appearing after two or more days has been said to be pathognomonic of hæmothorax, but reliance must

not be placed on this sign. The extent of the bruise is an indication of the number and size of the vessels which have been torn, or of hæmophilia.

2. **Is there rupture of a muscle?**—From a blow or sudden severe strain there may be more or less extensive rupture of a chest muscle, especially of the pectoralis major. If there is inability to raise the arm in front of the body, while on the patient's making the attempt to do this a gap is seen or felt in the pectoral muscle, this lesion is to be diagnosed.

If contraction of a muscle causes acute pain, and no fracture is present, and pressure on the painful part elicits tenderness, **bruise of the muscle** with slight rupture is the probable lesion. The pain of this injury may continue for some time, and when it implicates the intercostal muscles the symptoms simulate those of broken rib, as there is pain with all the respiratory movements, and some local tenderness; but the diagnosis is established by recognizing the absence of irregularity in the rib, of crepitus and of mobility, and by failure to elicit pain by pressure on the rib at a distance from the tender spot.

3. **Is there a swelling over the ribs?**—The eye, and especially the hand placed flat upon the chest, will decide this question at once. Such a swelling may be due to—

i. Hæmatoma; blood outside the chest.
ii. Emphysema; extravasation of air into the cellular tissue.
iii. Pneumatocele; hernia of the lung.

Notice whether the swelling is well defined, whether it fluctuates, whether it pits on pressure, or gives a soft crackling sensation to the fingers, whether it is resonant or dull on very light percussion, and whether it varies in size with inspiration, expiration, and coughing.

i. If it fluctuates, or if without fluctuation it is dull on very superficial percussion, unvarying in size with respiration, and non-crepitant, it is a **hæmatoma.** Hæmatoma will be distinguished from abscess by its early appearance after the injury, and by the absence of the usual signs of acute inflammation.

ii. If the swelling is ill defined, gradually extending, soft, even pitting on pressure, crepitant, resonant on very superficial percussion, and unaffected by respiration, it is **traumatic emphysema,** air having escaped from the lung into the cellular tissue of the chest wall. This may arise in one of two ways: (*a*) The lung may be ruptured by severe pressure upon the chest while the glottis is closed, the air passing under the pleura to the root of the lung, and thence spreading up to the neck and over the chest; in this case the swelling is first noticed about the neck and at the back, and not at a point which is the seat of considerable pain. (*b*) A fragment of a broken rib may lacerate the subjacent lung, and the air escape at each expiration into the superficial cellular tissue. The air may escape from the lung into the pleural sac and cause pneumothorax; more often there is no pneumothorax associated with the emphysema. This was formerly held to be explained by the occurrence of the fracture at the seat of an old pleuritic adhesion which prevented the air from passing into the pleura. It is now known that, in the absence of adhesions, air may pass from the wounded lung into the chest wall without causing pneumothorax. In these cases the emphysematous swelling appears first over the broken rib, at the seat of an acute stabbing pain, and not at the neck or back. Where there is *pneumothorax* there will be great dyspnœa on exertion, displacement of the heart to the opposite side, absence of breath-sounds, or amphoric respiration and the bell-sound; if there is no pneumothorax the vesicular murmur will be plainly audible and quite superficial all over the chest. The surgeon must not be misled to the diagnosis of pneumothorax by the existence of a tympanitic percussion note, as the presence of air in the superficial tissues gives that sign. The presence of the local form of emphysema indicates a fracture of a rib, with wound of the lung.

iii. If the swelling is clearly defined in outline, soft, crepitating, resonant on percussion, swelling out on expiration or coughing (which latter gives a distinct "impulse" to it), and sinking during a deep inspiration, it is a **pneumatocele** or **hernia of lung**, and indicates an extensive and serious lesion of the chest wall. This is a very rare complication of contusions; it is more frequent in wounds of the chest.

4. **Is there an injury (fracture or dislocation) of the bony and cartilaginous wall of the chest?**—i. After viewing the chest carefully, to discover whether there is any obvious deformity, and whether the respiratory movements are general, uniform, and free, pass the hand down the sternum, and then along the ribs from before back, in order from above down, and notice whether there is any irregularity in their outline; at the same time any local tenderness will be detected. If there is an abrupt sharp projection across the sternum, the projecting edge being continuous with one part of the bone, usually the upper, it will be from a **fracture of the sternum**; the lower fragment is generally displaced backwards beneath the upper. Should the projection be opposite the second costal cartilage, it

will be from a **separation of the manubrium from the gladiolus.** Care must be taken not to mistake for a fracture (*a*) the normal slight ridge across the bone at this level—this is smoother and more even than in fracture or dislocation—or (*b*) the smooth depressions sometimes met with in the lower part of the bone. Such a mistake is only likely to be made if there happens to be also local bruising occasioning pain, tenderness, and swelling.

ii. An irregularity in the line of a **rib cartilage** may indicate its **fracture,** or a projection where the rib joins the cartilage may show a **separation of the rib from its cartilage.** Care must be taken not to mistake for this the nodular enlargement of the part so common in rickets. The diagnosis will be easily made by noticing that the rickety swelling is symmetrical, affects many of the ribs, and is smooth and rounded, while the projection from dislocation affects only one or two ribs, and is more salient and irregular; mobility may be detected between the two parts.

iii. A marked depression, or angular projection, in the course of a **rib or ribs** may clearly establish the presence of a **fracture.**

If no irregularity of the bones is felt, place the hand firmly over the part where the patient feels pain, and induce him to breathe deeply, and then to cough; should crepitus be felt, it will determine the existence of a fracture. Some prefer to place a stethoscope over the most painful part, and to listen for crepitus during movements of the chest.

Should this yield no evidence of fracture, place one hand over the suspected region and make firm pressure with the other along the ribs and over the sternum; in this way crepitus may be elicited. If it is found that firm pressure on a rib causes a sharp pain at a distance from the point pressed upon, this may be taken as evidence of a fracture.

It has already been pointed out that the presence of local emphysema or of a pneumatocele proves the presence of a fracture of ribs.

In some cases the patient is able to give a clear history of hearing and feeling a bone snap at the time of the accident, and of feeling a grating sensation on taking a full breath; the sharp stabbing pain will always enable him to localize exactly the position of a fracture.

If the surgeon is unable to detect any irregularity of a rib, or to elicit crepitus, then a localized stabbing pain caused by any attempt to take a deep breath or to cough, and by pressure upon the rib at a distance, with spontaneous fixation of that part of the chest, will justify the diagnosis of fracture.

To obtain the most help from X-rays, especially in suspected fracture of the lower ribs, stereoscopic pictures must be obtained.

5. **Is there a lesion of the thoracic viscera?**—Cases of extensive laceration of the lung with laceration of large vessels, of double pneumothorax, or of rupture of the heart or great vessels, are usually speedily fatal, death occurring before any exact diagnosis can be made.

The observer should look for signs of collapse, or of loss of blood, and should notice the amount of dyspnœa present, as each and all of these signs are important as indicating that the injury is not a simple contusion of the chest walls, but is complicated with some more serious condition. There are two phenomena which at once enable a diagnosis of injury of the lung to be made. One is *subcutaneous emphysema*, showing that a rupture or wound of the lung has been produced, allowing air to escape from the alveoli. The other is *hæmoptysis ;* if bright-red frothy blood is coughed up, it proves beyond all doubt a lesion of some of the pulmonary vessels, and escape of blood into the bronchi. The amount of the hæmorrhage will be some guide to the extent of the lesion in the lung or to the size of the injured vessel.

In some cases a patient will cough up sooty or black sputa a few days after an injury to the chest; this arises from a small *bruise of the lung*, with hæmorrhage into the alveoli, the altered blood only passing slowly into the bronchi, and being expectorated after an interval.

The chest must be examined thoroughly to determine whether there is air or fluid in the pleural cavity, laceration of the lung, or deranged action of the heart. First note the relative size and the amount of expansion of the two sides; then the percussion note, the respiratory murmur, the voice-sounds, the position of the heart's impulse, and the character of the heart-sounds must be investigated.

If there is normal resonance all over the pulmonary area, with superficial vesicular respiratory murmur without râle everywhere, and normal voice-sounds, with a regular action of the heart and normal heart-sounds, the surgeon will be justified in deciding against any lesion of the lung or heart in the absence of any positive sign to the contrary, such as emphysema.

If soon after an accident the lower part of the pulmonary area is found to be dull on percussion, and over this area the vocal fremitus is weakened or abolished, while auscultation shows the respiratory murmur and vocal resonance to be feeble and distant, or absent altogether, and immediately above the dull area the physical signs are normal or indicate compression of the lung, a diagnosis of *hæmothorax* is to be made. If there is much pleural hæmorrhage there will be a corresponding degree of dyspnœa, and the usual signs of loss of blood. After two or three days a dark purple discoloration of the skin over the lower part of the chest behind and in the loins may be noted. The blood will almost certainly have come from the lung, and its presence may be accepted as a proof of *laceration of the lung;* where there is also hæmoptysis, this is beyond all doubt.

If one side of the chest is found to be expanded, with obliteration of the depressions along the intercostal spaces, and it gives a tympanitic percussion note, and the breath-sounds are weak, and distant, or inaudible, or amphoric in character, with perhaps coarse, crepitant râles, and "metallic tinkling" and the "bell-sound" are obtainable, while the heart is displaced to the opposite side, and the patient experiences severe dyspnœa on exertion, or even orthopnœa, it indicates *pneumothorax* from *rupture of the lung* through the pleura, the air having escaped into the general pleural cavity; this may or may not be combined with fracture of a rib, or with superficial emphysema. Occurring on the left side, it may obliterate the normal cardiac dullness, and so displace the heart as to render detection of the cardiac impulse impossible, and that of the heart-sounds very difficult. These signs may be present over a limited area of one side of the chest, the physical signs over the rest of the lung being normal; in that case there is a pneumothorax limited by old pleuritic adhesions.

If a combination of these physical signs is met with, a dull note with loss of voice- and breath-sounds and of vocal fremitus over the extreme base of the chest, and tympanitic resonance, amphoric respiration, the "bell-sound," "metallic tinkle," and succussion fremitus over the upper part of the chest, it shows that there is *hæmo-pneumothorax.* In all cases of pneumothorax there is some amount of blood in the pleural cavity, but it may be so small in quantity as not to give rise to any characteristic physical signs.

It is very important to observe whether a patient who is the subject of fractured ribs is also the subject of *emphysema of the lungs and chronic bronchitis.* A barrel-shaped chest, loss of power of expansion of the chest in inspiration, prolonged wheezing expiration, hyper-resonance, diminution of the area of cardiac dullness, prolonged expiratory murmur, and loud sonorous or sibilant râles will be the signs.

Lesions of the heart from contusions of the chest are much less common than those of the lung. If, however, immediately after such an injury a musical murmur is detected in connexion with either of the heart-sounds, and there is evidence that this is a sequel of the accident, either by the surgeon's previous knowledge of the patient or by the onset from the time of the accident of severe disturbance of the circulation, which is explicable upon the theory of interference with the function of one of the cardiac valves, it would be proper to diagnose a *rupture of a semilunar valve*, or *of chordæ tendineæ.* The signs of circulatory disturbance to be sought in such cases are faintness, a quick, feeble, soft pulse, or the suddenly collapsing pulse of aortic regurgitation, irregular and turbulent action of the heart, palpitation, dyspnœa, venous distension, and the signs of general pulmonary hyperæmia.

Ruptures of the large vessels of the thorax are very rarely caused by contusions of the chest, and are very rapidly fatal from internal hæmorrhage.

If immediately after a blow upon the chest the patient is cold and faint, with feeble rapid pulse and shallow irregular respirations, but a careful examination reveals no hæmorrhage, fracture, or abnormal dullness, and no cardiac displacement or bruit, the condition is one of **concussion of the chest.**

Severe compression of the chest is sometimes followed immediately by a diffuse purplish discoloration of the conjunctivæ, face, and neck; this is known as **traumatic cyanosis,** and its mode of production is not yet clear. The affected area is sharply limited below by a horizontal line about the level of the clavicles. The condition is not of serious import, nor does it add to the gravity of accompanying injuries to the chest.

Injuries of the abdominal viscera are considered in Chap. XIII.

II. WOUNDS OF THE CHEST

Wounds of the chest are of much less frequent occurrence than contusions, and are usually produced by stabs, bullets, or pieces of shell, and therefore they are most common in military surgery. In any given case the surgeon should seek an answer to four questions:

1. **Is the wound penetrating or non-penetrating?**—That is, is it limited to the chest walls, or does it extend into one of the three serous cavities of the chest or into the mediastinum? The surgeon should attempt to show that it is penetrating, and only in the absence of all evidence to the contrary consider it non-penetrating; but care must be taken in exploring a wound lest penetration be caused; reliance must be chiefly placed upon signs of lesion of the thoracic contents. In some cases the wound is evidently quite superficial,

and the question of penetration can hardly be said to arise. In other cases, especially in extensive shell wounds, air and blood pass in and out of the wound with a loud sucking sound that puts the question of penetration beyond any doubt.

If there is no emphysema around the wound, no passage of air through it during respiration (traumatopnœa), no pneumothorax, hæmothorax, or prolapse of lung, no hæmoptysis, no disordered action of the heart, and no dysphagia, there is no evidence to warrant the diagnosis of penetration; but even in these circumstances, if the nature of the injury makes penetration probable, it is only when no secondary inflammatory complications arise that an absolute diagnosis of *non-penetration* can be made. If the wound is a bullet wound, the situation of the bullet, if still in the body, as revealed by the X-rays, will usually settle this point.

2. Is the wound attended with hæmorrhage? If so, what is the source of the bleeding?—Blood may escape externally through the wound, or be coughed up mixed more or less thoroughly with air. But bleeding may be internal, and unrecognized unless a thorough examination is made. The constitutional signs of loss of blood (pallor, vertigo, syncope) must be carefully noted, and search should be made for evidence of hæmothorax, hæmopericardium, and hæmomediastinum. The signs of *hæmothorax* have been given already (p. 134).

If, quickly after a wound, the normal cardiac dullness is increased, the impulse of the heart is displaced upwards or lost, and the sounds are indistinct or inaudible, especially over the lower part of the dull area, with feeble or turbulent action of the heart as shown by the pulse, **hæmopericardium** may be diagnosed.

If, with a sense of oppression across the chest and dyspnœa, there is found dullness behind and on each side of the sternum, with loss of cardiac impulse and extreme weakness of the heart-sounds, and distension of the veins of the neck, **hæmomediastinum** may be diagnosed.

These last two conditions may coexist, and the distinction between them may be very difficult; the position and known direction of the wound may afford some aid in diagnosis. Blood in the pericardium leads to much more rapid and serious disturbance of the heart's action than when it is extravasated in the mediastinum.

It must be remembered that external and internal hæmorrhages often coexist, and although in all cases a careful examination to detect the latter should be made, the necessity for it becomes more urgent when the general signs of loss of blood are greater than can be accounted for by the external flow. The examination must, however, be conducted with the greatest care, as undue movement or excitement of the patient may lead to a recurrence of hæmorrhage which has been arrested.

The fact of hæmorrhage being established, an attempt must be made *to determine its source.* The position of the wound, and of the accumulated or flowing blood, is an important aid in arriving at a conclusion. The intercostal vessels run along the lower border of the ribs; the internal mammary vessels run vertically down behind the costal cartilages, ½ in. from the edge of the sternum. Wounds, therefore, in these situations may involve those vessels, and if the hæmorrhage is solely external, and moderate in amount, or if the blood flows *per saltum* and is unmixed with air, a wound of a **parietal vessel** is to be diagnosed. If the bleeding can be stopped by pressure with the finger against the upper of the ribs bounding the wound, the hæmorrhage is from a parietal vessel. But when the hæmorrhage is excessive, and gives rise to hæmothorax, or when the blood is of a bright-red colour and mixed with air, while similar blood is expectorated, especially if the blood-flow varies with respiration, and is attended with traumatopnœa or extensive emphysema, it may be regarded as coming from the **lung.** Free hæmorrhage from a wound of the heart and great vessels is usually complicated with hæmorrhage into the pericardium or mediastinum, and is quickly fatal.

It must be added that the diagnosis between parietal and visceral hæmorrhages may be impossible without exploration of the wound, and also that they may coexist.

3. **Does the wound implicate a viscus?**—This is the most important question in reference to wounds of the chest, as upon the correct answer to it the prognosis largely depends.

i. If a wound of the chest is attended with moderate emphysema, or slight traumatopnœa, or pneumothorax and collapse of lung, and there is no evidence of external hæmorrhage more than that accounted for by the external wound, and no hæmothorax, and no hæmoptysis, the diagnosis of wound of the **pleura** without injury of the lung is to be made; this lesion is rare, and is met with towards the extreme base of the lung, and as a result of wounds by not very sharp instruments.

ii. If instantly or quickly following a wound of the chest a soft, smooth, dark-purple mass is found projecting from the wound, elastic and crepitant to the fingers, it is a **hernia of the lung** due to a wound of the pleura. This is met with especially in wounds of the front of the chest, near the fissures of the lungs. The appearance and feel of the lung are characteristic, but a protrusion of very congested omentum has been mistaken for the lung—a mistake which may be avoided by noticing the lobulated condition of the omentum, and the smoothness and crepitation of the lung.

iii. Where there is extensive emphysema complicating a wound, or marked pneumothorax, hæmothorax, free hæmoptysis, or distinct traumatopnœa, and especially where two or more of these signs are met with together, there is a **wound of lung.**

iv. If a wound over the region of the heart is followed by tympanitic resonance over the cardiac area, with (sometimes without) a loud ringing character of the heart-sounds, and if, after a short interval, there is dullness over more or less of the lower part of the cardiac area, with a tympanitic note above, a raised position of the heart's impulse, dyspnœa, distress, epigastric pain, and quickened feeble pulse, followed in a few hours by pericardial friction, the evidence warrants the diagnosis of wound of the **pericardium,** leading to *pneumopericardium*, *hæmopericardium*, and *pericarditis.*

v. If a wound over the heart is immediately followed by considerable shock and syncope, with free external bleeding, or evidence of internal bleeding into the mediastinum or pericardium, with rapid weak pulse, there is a wound of the **heart.** Should a foreign body, such as a long needle, be found in the wound, and this is noticed to move with every pulsation of the heart, it may be assumed that it is embedded in the heart wall. There is often considerable anxiety and fear in cases of wound of the heart; they may be extremely difficult to diagnose, and some reliance must be placed upon the nature of the injury and the amount of the hæmorrhage. The position of the wound will enable the surgeon to determine approximately which part of the heart is wounded.

vi. A wound over the great thoracic blood-vessels, followed by profuse hæmorrhage and all the signs of extensive *hæmomediastinum*, with collapse, syncope, and dyspnœa, is complicated with wound of **a great blood-vessel**; such injuries are, with few exceptions, fatal in a few hours.

vii. If there are spitting of blood and dysphagia, and liquids swallowed are found to escape at the external wound, there is a wound of the **gullet.**

viii. Where, after a wound in the chest, there is a flow of clear serous fluid which becomes milky in appearance after a full meal, and the fluid on examination is found to consist of a very fine molecular base with globular nucleated corpuscles, and to contain much fat, a wound of the **thoracic duct** is to be recognized. This injury is very rare. If the fistula continues open it leads to considerable emaciation and exhaustion.

4. **Is there a foreign body in the wound?**—In some cases it is extremely easy to answer this question, but in many others it is quite impossible. A knowledge of the mode of infliction of the wound, whether by gunshot, stab, or prick, is important, and an examination of the clothes should always be made. In cases of stab wound the weapon used should be carefully examined for any evidence of recent fracture. In cases of bullet wound an inspection of the revolver may show how many bullets have been discharged, and they should then be sought for where the shots were fired, and in the patient's clothes. By these means it may be shown to be extremely improbable, or practically certain, that a foreign body is lodged in the wound.

The next step will be to examine the wound. A knife-blade may be found transfixing a rib, or the end of a needle projecting through or under the skin, or a finger or a probe may detect a bullet in the wound, or a fragment of a rib. *Skiagrams* taken in two planes at right angles will reveal a metallic foreign body if present, and careful localization will enable its exact position to be determined. Where there is a history clearly pointing to the lodgment of a foreign body, the onset of acute inflammation of the wounded part running on to suppuration confirms the suspicion. In some instances, when the collection of pus (empyema or pulmonary abscess) has been evacuated the foreign body has been discharged with the pus, or detected on an examination of the cavity with the probe, and then removed. In the case of a needle or knife-blade or similar body transfixing the præcordial region, if a movement is communicated to it by the contraction of the heart it shows that it is **impacted in the heart.** Where the history indicates the lodgment of a foreign body in the pulmonary region of the chest, and there are no indications of a wound of the lung, and acute pleurisy and empyema ensue, it points to the presence of the foreign body in the **sac of the pleura.** Where, on the other hand, the signs are those of wound of the lung, and especially if pneumonia occurs and a pulmonary abscess suddenly bursts into a bronchus, lodgment of the body **in the lung** is indicated.

III. SECONDARY COMPLICATIONS OF INJURIES OF THE CHEST

The sequelæ of injuries of the chest are, with one exception, inflammations of the various structures involved, and they frequently terminate in suppuration. It may be useful to append a list of them :

1. Traumatic myositis.
2. Subpectoral abscess.
3. Peripleuritic abscess.
4. Pleurisy.
5. Empyema.
6. Pneumonia.
7. Gangrene of lung.
8. Mediastinal abscess.
9. Pericarditis.
10. Myocarditis.
11. Endocarditis.
12. Pneumatocele.

If the patient convalesces without pyrexia, pain, dyspnœa, syncope, palpitation, or other sign of respiratory or circulatory difficulty, it indicates an absence of these complications. But the accession of pain, and especially of fever, with or without an initial rigor, of increased dyspnœa, or of signs of cardiac failure, should at once excite suspicion, and lead to a careful examination of the chest, while a knowledge of the nature of the original injury will suggest the inflammatory lesions to be especially anticipated. Thus, simple fracture of a rib is not infrequently followed by pleurisy, with or without effusion, wound of the pleura with hæmothorax often runs on to empyema, and wound of the lung to pneumonia, while a bruise may lead to "muscular rheumatism."

First examine the chest walls for evidence of myositis and of swelling, and then make a systematic physical examination of lungs and heart.

1. If after a contusion of the chest, or some sudden strain, the patient continues to suffer from a localized pain on taking a deep breath, or on coughing, or on attempting to contract any of the thoracic muscles, and if the painful part is also tender but there is no evidence of fracture of a rib, or of pleurisy, or of other intrathoracic complication, **traumatic myositis** must be diagnosed.

2. When with the general signs of inflammation the front of the chest is found swollen, the swelling being ill defined, boggy, and œdematous in nature, attended with considerable pain and tenderness and great pain on raising the arm forwards; and, further, when it is known that this swelling did not immediately follow the injury, a **subpectoral abscess** is to be diagnosed. Fluctuation is felt first in the axilla, but the pus may be too deep to give this sign.

3. If, after a contusion or small punctured wound of the chest which has healed, the patient becomes ill, with high temperature, perhaps a rigor or rigors, with pain in the side, the site of the injury should be carefully examined. If, now, that part of the chest is found enlarged, with one or more intercostal spaces widened and bulging, if fluctuation can be detected in these bulging spaces, and if they become less prominent during inspiration and more tense and full during expiration; if this area is dull on percussion and vocal fremitus is abolished over it, and the respiratory murmur is weak, but there is no friction heard; and, further, if the heart is not displaced to the opposite side, nor the liver or other abdominal organs depressed, **peripleuritic abscess** should be diagnosed.

In such a case the diagnosis lies between empyema and peripleuritic abscess, and attention must be directed especially to the following points:

(*a*) In empyema the chest distension is uniform, and "pointing" is a late sign; in peripleuritic abscess the distension is more localized, and "pointing" is noticed earlier. (*b*) In empyema the dull area nearly always involves the lowest part of the pleural sac, even if it rises high, and its upper level may be modified by position; in abscess there may be a resonant area below the dull area, in which the respiratory movements and sounds are normal, and the level of dullness is quite unaffected by position. (*c*) In empyema there is displacement of the neighbouring organs, in abscess there is not. (*d*) In empyema a difference in tension of the swelling during inspiration and expiration is not observed.

Peripleuritic abscess is a very rare affection; it may arise spontaneously as well as from injury; it may burst into the pleura and set up empyema, or spread to the mediastinum and pericardium.

4. If, on auscultating the chest, a dry rubbing or creaking sound is heard with inspiration and expiration, limited to a certain area of the chest, and unattended with dullness on percussion, it indicates **dry pleurisy.** Such friction may be heard just above a pleuritic effusion or over a pneumonic lung.

5. If one side of the chest is found enlarged, with bulging of the intercostal spaces and great lessening of the respiratory movements, and it is dull on percussion, with loss of vocal fremitus, while the breath-sounds are inaudible, or are distant, weak, and bronchial in character, and the vocal resonance is distant and bronchophonic; and if, further, there is displacement of the heart to the opposite side, there can be no doubt that there is fluid in the pleural sac. These signs, found quickly after the injury, point to *hæmothorax;* coming on after an interval of a day or two, or increasing at that time, and especially if attended with fever and increasing dyspnœa, they indicate *pleurisy with effusion;* while if the temperature continues to rise and remains high, or if there are rigors with sweatings, and emaciation, or if a localized fluctuating swelling forms in any part of the chest wall, **empyema** is to be diagnosed. When there is doubt as to the nature of the fluid, the needle of an exploring syringe

should be introduced and a portion of the fluid withdrawn for examination.

6. If examination of the chest shows localized dullness around the wound, with tubular breathing, fine crepitation, and bronchophony, and the patient is febrile, with sharp pain in the chest, cough, and rusty expectoration, **traumatic pneumonia** is to be diagnosed. This form is less severe and less extensive than the idiopathic. If it is combined with pleurisy, the physical signs will be modified, and reliance on the diagnosis of **pleuro-pneumonia** will be placed especially on the combination of rusty expectoration, tubular breathing, fine crepitation with loss of vocal fremitus, bulging of intercostal spaces, and perhaps friction. Should the inflammation attack a portion of lung that has been wounded, coarse moist râles may be heard. If, in a case of pneumonia, the patient suddenly coughs up a quantity of pus, it will point to an **abscess** in the lung, which has burst into a bronchus; if now the signs of a cavity are present where before there was evidence of pulmonary consolidation, this diagnosis and the exact position of the abscess will be established.

7. If, with or without evidence of traumatic pneumonia, the patient, some days after the injury, coughs up dark and extremely fetid sputa, and the breath has a horribly fetid odour, the diagnosis of **gangrene of the lung** is to be made. This may be confirmed by detecting shreds of pulmonary tissue in the expectoration, the elastic fibres having a characteristic clear, defined outline under the microscope, and resisting the action of acetic acid. An attempt should be made to localize the gangrene for the purpose of treatment; and if an area of dullness, with moist râles and hollow respiratory murmur, is detected, that may be regarded as the seat

of the disease. Gangrene is a rare sequel to chest injuries, but is met with occasionally after contusions and wounds, particularly if the lung is much lacerated or a foreign body is retained.

8. If in a case of *pneumo-* or *hæmomediastinum*, or of severe blow upon or wound of the sternum, the distress of the patient becomes considerably increased, and there are palpitation of the heart and dyspnœa, or œdema and signs of venous obstruction in the head, neck, and upper limbs, and on percussion a dull area is found over the sternum and extending laterally over the costal cartilages, or behind on either side of the vertebral column, and if there is pyrexia, with perhaps rigors, the surgeon must suspect **mediastinal abscess,** and at once explore the part by trephining the sternum. The abscess may "point" at the suprasternal notch or intercostal spaces close to the sternum or at the epigastrium, as a soft, fluctuating swelling which may have a pulsation transmitted from the heart, or become fuller and tenser during expiration. Or the abscess may suddenly burst into either the pleura or the pericardium, setting up acute inflammation. Death often takes place before pointing has occurred.

9. Even within a few hours after a wound of the pericardium, friction may be heard over the cardiac area, showing the development of **pericarditis.** Pericardial friction is to be distinguished from pleuritic friction by the place where it is heard, by its being unmodified by respiration, and by its accompanying both sounds of the heart. It is distinguished from endocardial murmurs by its creaking or rubbing character, its uniformity with both sounds of the heart, its strict limitation, its want of conduction along the vessels or into the axilla, and in some cases by its modification

on firm pressure with the stethoscope. If this is followed by an increase in the area of cardiac dullness which takes the shape of the pericardium, with displacement of the heart's impulse upwards and to the left (the impulse may be quite lost), increased frequency of the heart's action, and loss of the heart-sounds over much of the dull area, while the pulse is small and weak, and dyspnœa very marked, the patient sitting up in bed and leaning forwards, and having a frequent, dry, short cough, **pericardial effusion** has occurred. Should rigors occur, and there be a tendency to "point" in any part of the dull area, **pyopericardium** may be diagnosed; an exploring syringe will determine the nature of the fluid in the sac.

10. When, in connexion with pericarditis, the heart's action becomes extremely weak and irregular, leading to syncope on movement or on sitting upright, the existence of **myocarditis** is to be inferred.

11. If the surgeon is able to recognize the development of an endocardial murmur after a contusion, strain, or other injury of the chest, i.e. if he at his early examination finds the heart-sounds clear, and subsequently notes a murmur, it is evidence of the occurrence of **endocarditis.**

12. If, after a wound in the chest has healed, or after a severe contusion, a tumour slowly and gradually appears, which is circumscribed, smooth, soft, rounded, crepitant under pressure, resonant on light percussion, with an impulse on coughing, expanding with each expiration and contracting during inspiration, it is a consecutive prolapse of the lung, or a **pneumatocele.** These tumours may appear rapidly and attain a large size; they may be more or less reducible, and allow the outline of the aperture through which the lung escapes to be felt.

CHAPTER XIII

DIAGNOSIS OF INJURIES OF THE ABDOMEN

INJURIES of the abdomen, as of the head and chest, derive their chief importance from the great danger of damage to the viscera contained within the cavity. Hence the question which above all presses for an answer is, whether any given injury has merely bruised or wounded the parietes, or whether there is a visceral lesion as well; and if the latter, which of the several viscera has been damaged. While visceral lesions are generally the result of the more severe forms of violence, the surgeon must always remember that even by apparently trivial blows fatal visceral ruptures may be caused. In arriving at a diagnosis of a case of abdominal injury it is well to consider that the patient is the subject of a visceral lesion until the contrary can be proved, and to employ the method of exclusion.

When examining the patient the utmost gentleness of manipulation must be employed, lest the surgeon's fingers or the patient's movements should convert an incomplete into a complete rupture, or induce a renewal of hæmorrhage that Nature has arrested.

Abdominal injuries are to be divided into **contusions** and **wounds,** of which the former are much the more common in civil practice, and form an exceedingly serious and highly fatal class of case. The sequelæ of each group will be considered separately.

Exact diagnosis may be impossible. The absence of all acute symptoms, or of symptoms distinctly pointing to a visceral lesion, is not enough to justify the surgeon in proclaiming the injury unimportant. For example, there may be nothing soon after the injury to indicate even such a severe lesion as a rupture of the intestines, but in a few hours the onset of acute peritonitis will reveal the gravity of the case. The same holds good in the case of wounds. It is only if the patient *continues* to be free from severe symptoms that a diagnosis of a simple superficial lesion can be made. But as treatment, to be successful, should anticipate the occurrence of peritonitis, it is bad practice to wait for the development of symptoms of inflammation. In many cases, therefore, where an actual diagnosis of visceral lesion is not possible, an exploration should be made. This applies particularly to the intestine, perforation of which may be unattended at first by any definite symptoms; injuries of the solid viscera are always attended by hæmorrhage, and this makes them more readily recognizable.

I. **Abdominal contusions.**—There may be no external indication of the severity of the internal injury; every case, however trivial it may seem, must be most carefully investigated and watched. It is important to know the nature and severity of the injury, whether a fall, or blow, or crush; also the exact spot struck, and the condition of the hollow viscera at the time, especially whether the stomach or bladder was full. The symptoms to which special attention must be paid are those of collapse, of hæmorrhage, of free gas or free fluid in the peritoneal cavity, of rigidity of the abdominal muscles, and such local signs as pain, tenderness, vomiting, hæmaturia, and emphysema.

Notice very carefully the patient's temperature, colour, and general demeanour—whether cheerful, depressed, quiet, listless, restless, or unconscious—the pulse-rate and tension, the fullness and ease of respiration, the softness and freedom of mobility of the abdominal walls, the presence of any swelling in either flank or elsewhere, the exact distribution of resonance and dullness in the entire area of the abdomen; and examine vomited matter and anything passed from the bowel or urethra—often it is necessary to pass a catheter, and the amount of urine withdrawn, and the rapidity of its flow, must be noted, as well as whether it contains blood. The time of onset and variation in intensity of these symptoms must be carefully noted.

Shock is most intense immediately after the injury; it is an indication of excessive nerve stimulation; it is most severe when the blow is over the solar plexus—in the upper half of the abdomen—and when the stomach is full, so that the full force of the impact is transmitted to the nerves. It may be absent, or very slight and transient, in rupture of the intestine and rupture of the bladder.

But it must be remembered that sudden intense emotion, in particular fear, is capable of producing a marked degree of shock. In nervous individuals shock may result therefore from fright in anticipation of an injury which proves to be trivial.

Hæmorrhage, a very important symptom, may be *external*—vomited, passed from the bowel or with the urine—or *internal*. The general signs of bleeding vary with the rapidity and amount of the loss, and are to be distinguished from the symptoms due to shock by their gradual increase. When the bleeding is internal it is recognized by the general signs of acute anæmia and by the presence of abnormal swelling and dullness. Shifting dullness shows the presence of free fluid in the peritoneal cavity; such fluid may be blood or urine, serum or bile. Percussion should be made very carefully and lightly, not only to avoid giving pain and exciting muscular spasm, but because by very light percussion the slight alteration of resonance caused by a limited clot among the intestines can be demonstrated. Extraperitoneal hæmorrhage forms a swelling uninfluenced by posture, and often causes subcutaneous ecchymosis. Urine, bile, and cystic fluid, mixed with more or less serum, will give signs of the presence of free fluid in the peritoneum, often without signs of hæmorrhage, in cases of rupture of the bladder, of the gall-bladder, or of a cystic—e.g. ovarian—tumour.

Free gas in the peritoneum is recognized by loss of liver dullness, and in some cases by hyper-resonance at the epigastrium or hypogastrium; it results from rupture of the stomach or intestine.

Subcutaneous emphysema is not often observed in connexion with abdominal injury; when it is, care must be taken to determine whether it is thoracic or abdominal in origin. Of the former we have previously spoken (*see* p. 130); the seat of the injury and the place where the swelling first appears are the signs by which this distinction is to be drawn. When abdominal in origin, it usually makes its appearance first in one or other loin or groin, and it indicates a rupture of the intestine; and when, as is usually the case, it is not combined with pneumo-peritoneum, or gas in the general peritoneal cavity, it points unmistakably to a rupture of some part of the gut where it is uncovered by peritoneum, such as the back of the ascending or descending colon. The same symptom is occasionally observed in injuries of the rectum.

Rigidity of the abdominal wall is an extremely important sign of visceral injury—it may be very slight and local, or intense and general, greatly modifying respiration. When a patient can take a full deep breath without any pain, and the abdominal wall is everywhere quite soft to the touch, it is *almost* certain that there is no visceral injury or peritonitis. But in some cases of visceral injury it is only after many hours that this freedom of mobility gives place to increasing rigidity.

Pain is a symptom of all injuries; when it is intense and increases spontaneously—i.e. without any movement on the part of the patient—or is fixed in one spot and radiates thence over the belly, it becomes of serious portent. *Vomiting* is another very frequent symptom. When a person receives a blow on the belly soon after a meal, vomiting to the extent of emptying the stomach is common, and has no serious significance; but when the vomiting is often repeated, and particularly when the ejecta contain blood or bile, it is an important sign of visceral lesion. The significance of *hæmaturia*, or of the passage of *blood by the bowel*, is obvious, but it may be remarked that if bright-red blood is passed per anum as the result of an abdominal injury it points to a lesion of the lower colon, while an altered condition of the blood (tarry stools) would show that it comes from some part of the alimentary canal farther removed from the anus.

If, after an injury to the right hypochondrium, there are fixed and severe local pain and tenderness, **rupture of the liver** must be suspected. Marked and increasing collapse and signs of internal hæmorrhage, with increase of the liver dullness and shifting dullness in the right flank, and frequent vomiting, would make the diagnosis certain. The vomit often contains bile but no blood: if the patient survives, jaundice, the passage of clay-coloured stools, ascites, and the presence of sugar in the urine may be observed.

If a blow upon the left hypochondrium is followed by deepening collapse, blanching of the surface, and other signs of internal hæmorrhage, and if pressure under the left margin of the chest elicits tenderness, and especially if the splenic dullness is increased downwards and forwards, the dullness in the left flank not being affected by change of posture, a **rupture of the spleen** is to be diagnosed. Internal hæmorrhage is the great feature of this injury, and evidence of this, together with the position of the blow, and of the dullness caused by the accumulating blood, are the signs to be relied upon for diagnosis.

In some cases of rupture of the liver or spleen the onset of signs of internal hæmorrhage is delayed twelve or even twenty-four hours.

When an injury to the loin is followed by hæmaturia, the blood being intimately mixed with the urine, sometimes forming long slender "casts" of the ureter, a **rupture of the kidney** of the same side is to be diagnosed. Should the loin be found bruised, painful, and tender, and there be pain in, or retraction of, the testicle, or pain or numbness down the front of the thigh, the diagnosis will be confirmed. When the patient has received a very severe crushing injury of the loin, and there are much bruising of the part, deep swelling, pain, and tenderness on trying to feel the kidney, and especially when, combined with these signs, there is marked collapse, a rupture of the kidney may be diagnosed, even in the absence of hæmaturia; in these cases either the kidney is severed from the ureter, or the ureter is blocked.

For the diagnosis of *rupture of the bladder* see p. 174.

If an injury to the epigastrium or left hypochondrium of a patient who has recently taken a meal is immediately followed by intense pain in the injured part, which quickly radiates over the whole belly, by extreme collapse from which the patient does not rally, and by repeated painful vomiting with hæmatemesis, the diagnosis of **rupture of the stomach** may be arrived at. Rigidity of the abdominal wall, and resonance over the usual seat of liver dullness showing free gas in the peritoneum, are generally present, and aid in the diagnosis. The usual signs of peritonitis quickly supervene. This injury, fortunately, is rare; it only occurs when the viscus is more or less distended.

When a blow upon the umbilical region of the abdomen causes shock, and is quickly followed by the evidence of acute peritonitis, a **rupture of the small intestine** may be diagnosed. At first there may be no indication of this very serious lesion; there may be no marked shock, no vomiting, no muscular rigidity, no loss of liver-dullness, and yet successful treatment depends upon the immediate recognition and suture of the rupture. Special attention must be paid to the nature of the injury, to the force and the size of the contusing body: a blow with a small object like the end of a shaft or the handle of a handcart, or a piece of wood flying from a circular saw, is more liable to rupture the intestine than a fall from a height. Very violent contusions, as in buffer squeezes, are also prone to inflict this injury. If after such an injury there is noticed even very slight impairment of the free movement of the abdomen in respiration, or even very slight rigidity of the belly wall, or any slight local alteration in resonance, an injury to the bowel should be provisionally diagnosed, and an exploration of the part carried out without delay. A *progressive increase in the pulse-rate* from hour to hour is extremely suggestive of a visceral lesion, apart from local symptoms. To wait for proof of the rupture is to lose the golden opportunity for treatment.

When signs of internal hæmorrhage supervene upon an abdominal contusion and there is no indication of injury of either of the solid viscera, the source of the bleeding is **one of the larger abdominal vessels,** and only an exploration can determine the exact source of the hæmorrhage. The intensity of the symptoms and their rapidity of onset merely indicate the size of the ruptured vessel—this may be the vena cava, the portal vein, or one or more of the mesenteric vessels.

When, after a sudden strain or severe injury, the patient complains of a sharp pain in the left side of the chest, and of dyspnœa, and is found unable to take a full inspiration and to "fix" the diaphragm, a careful examination of the left chest should be made. If now the heart's apex is found displaced to the right, and the normal area of pulmonary resonance is encroached upon from below by the tympanitic note of the stomach or colon, or by dullness, and the respiratory sounds are absent over the same area but of normal character above, and if, further, the patient complains of severe thirst, and is repeatedly sick, **rupture of the diaphragm, with hernia,** may be recognized. This accident always occurs on the left side, and it may be but a part of a very severe and quickly fatal lesion, and escape recognition. When resulting from a sudden spasm of the muscle, the sharp pain, followed by inability to fix the diaphragm, the thirst, and the special physical signs clearly point to the nature of the lesion. Diaphragmatic hernia may be a congenital affection, and, therefore, it is only when the symptoms associated with it come on acutely after a strain or injury that the traumatic lesion must be diagnosed.

If a pregnant woman receives a blow upon the belly, and complains of pain shooting down to the vulva, perineum, and thighs, and if the outline of the uterus is preserved unaltered, and there is neither hæmorrhage from its cavity nor severe collapse, it is a **contusion of the uterus**; abortion will probably result.

If, in similar circumstances, the woman is found collapsed, with signs of loss of blood, and blood is found flowing from the uterus into the vagina, **rupture of the uterus** has taken place; and if the outline of the uterus is lost and, in place of it, the head and limbs of the fœtus can be plainly traced through the belly wall, the fœtus has escaped through the rent into the peritoneal cavity.

If a woman known to have an ovarian tumour falls or receives a blow upon the belly, and then becomes faint and complains of pain, and the outline of the tumour is altered or quite lost, and there is dullness in each flank, which disappears on turning the patient on to the opposite side, **rupture of an ovarian cyst** is to be diagnosed. Even without the knowledge of the prior existence of an ovarian tumour, the detection of free fluid in the peritoneal cavity immediately after an injury to the belly of a woman would render the diagnosis of rupture of an ovarian cyst very probable. Collapse, and the history of a "snap" or "bursting" experienced at the time, especially in the absence of jaundice, and of disease of the heart or lungs, would support this diagnosis.

In the absence of severe or increasing collapse, of severe pain, of vomiting, of emphysema, of hæmaturia, and of alteration in the abdominal resonance and movements, the probability is that there is *no visceral lesion;* but such a conclusion is conjectural, and becomes absolute only when the patient continues without signs of peritonitis or the formation of a tumour.

A swelling of the abdominal wall with more or less discoloration from ecchymosis will indicate a **bruise of the abdominal wall**: the part will be tender, with slight dull pain which is increased by contraction of the abdominal muscles in respiratory or general movements. If on putting the abdominal muscles into action a gap can be felt, it is due to **rupture of a muscle**: this is especially liable to involve the rectus abdominis; it is accompanied by swelling from hæmorrhage, and a marked sense of weakness when the muscle contracts.

II. **Sequelæ of abdominal contusions.**—These are:

Peritonitis.
Abscess.
Pancreatic cyst.
Urinary cyst.

The most frequent and the most fatal sequel to an abdominal contusion is **peritonitis.** It may result from a perforation of any part of the alimentary canal, or from any less severe injury which permits pathogenic organisms to traverse the intestinal walls and infect the peritoneum, or from bruises or ruptures of other organs becoming infected by organisms circulated in the blood-stream. The results of the peritoneal infection vary: it may be followed by a plastic peritonitis which encloses the infective organisms and ends in *adhesion* of neighbouring viscera or in a localized *abscess*, or, if the infection is more intense, it becomes widely diffused over the peritoneum and causes *general peritonitis* and death from *toxæmia.*

The **symptoms** will therefore vary; they are of two kinds, those due to toxæmia and those caused by interference with the function of the inflamed parts. The following points must be observed in examining patients after abdominal contusions:

The *temperature:* a slight temporary rise is the *traumatic fever* which may follow any injury; when there is severe bruising of abdominal muscles or of a solid organ such as a kidney, there may be slight fever lasting many days, but in the absence of infection this fever is unaccompanied by other symptoms; a rapid progressive rise is an important sign of *infection;* in some cases of intense peritonitis, especially in old people, the temperature may be but little raised.

The *pulse:* increased frequency is an almost invariable accompaniment of peritonitis throughout its course; when the inflammation is limited the pulse may be small and hard; in diffuse peritonitis the pulse quickly becomes very rapid, soft and running.

The *facies:* an anxious expression, drawn features, slight lividity of the lips, restlessness and wakefulness are very frequent effects of peritonitis; the mind usually remains clear quite to the end, and the patient is unaware of his grave condition. The *tongue* may remain clean, but is more often thinly furred and may become dry; *thirst* is often distressing. *Vomiting* is a very frequent symptom; it is characterized by the slight force with which the contents are ejected, its frequent recurrence, and the dark colour of the vomited matter owing to admixture with blood from the deeply congested stomach; oftentimes single mouthfuls of dark fluid are gently regurgitated.

Pain: at the onset of peritonitis there may be acute pain, either general, or referred to the seat of the original mischief or to the umbilical region. In localized peritonitis the pain remains localized, and is a fair measure of the intensity of the inflammation, becoming more severe when an abscess forms. In diffuse peritonitis there may be no local pain; sometimes it is referred to the back only. *Tenderness* is usually well marked in local peritonitis, and increases when pus forms; it may be very pronounced in the early stages of general peritonitis, and become less severe towards the end; in some cases it is absent throughout.

Rigidity of the abdominal walls is one of the most constant symptoms of peritonitis. In localized peritonitis it is limited to the part of the wall over the inflamed area, in the diffuse inflammation it is general; in these cases it may pass off in the later stages, and very occasionally it is absent throughout. *Intestinal peristalsis* is very generally arrested by peritonitis; neither fæces nor flatus is passed, and the bowel does not respond in the usual way to the stimulus of a purgative or an enema; occasionally, however, diarrhœa occurs. *Abdominal distension* is a very frequent symptom; it is due, in part, to the arrest of intestinal peristalsis, but still more to chemical changes in the bowel attended with the evolution of gas. It comes on early in general peritonitis, increases to the end, and often attains an extreme degree; it may attend a localized peritonitis, and in that case it comes on more gradually; in such a case it is often the precursor of a wider extension of the peritonitis. *Respiration* becomes thoracic in character, partly from the rigidity of the abdominal muscles, partly because of the pain created by any abdominal movement, and later on also from the great abdominal distension. In the late stages of general peritonitis the breathing is rapid, laboured, and ineffective, the blood becoming less and less oxygenated. The *circulation* gradually fails in general peritonitis, the extremities become cold, the capillary circulation is sluggish, and the pulse may disappear at the wrist for an hour or so before death. The *urine* is scanty, sometimes suppressed; in general peritonitis it may become albuminous. *Leucocytosis* is observed in all grades of acute peritonitis; it is more marked in general than in local peritonitis, and when an abscess forms.

It is not well to rely for diagnosis upon any one of these signs, but rather upon the combination of many. It must be borne in mind that of them all the pulse is the most important, and next to it rigidity of the abdominal wall.

Peritonitis usually arises, if at all, within a few hours of the accident, but in some cases it may be delayed for two, three, or even four days If, therefore, soon after an abdominal contusion the patient complains of pains in his belly or in his back, and the temperature is raised, the pulse quickened, the abdominal walls are motionless, the intestines distended, and no flatus has been passed, the diagnosis of **general peritonitis** must be made. An anxious, pinched expression of face, frequent vomiting, scanty urine, and increasing distension, with failing circulation, will make the diagnosis more certain. In a doubtful case, if a blood-count shows a rapid rise in the number of polymorphonuclear leucocytes, this will be an important confirmation of the diagnosis.

If the patient complains of pain limited to an area of the abdomen, and this part is tender, with local muscular rigidity, and the temperature and pulse are raised, **localized peritonitis** is present. With this there may be limited swelling, occasionally vomiting, constipation, and slight leucocytosis. All these symptoms may entirely pass off as the inflammation subsides, but in other cases **adhesions** persist and make their presence known by occasional paroxysmal pains, local tenderness, and constipation; constipation is often the cause of these recurrent attacks.

When a contusion of the abdomen is followed by the formation of a localized swelling and general febrile disturbance, an **abscess** must be suspected. Such swelling may follow an obvious bruise of the belly wall, in which case the onset and progress of inflammation are marked by increasing swelling, bright redness, œdema, greater pain, acute tenderness, and fever. Or there may have been no external evidence of bruising, and febrile illness, local pain, and then the gradual occurrence of a more or less well-defined swelling may be the only symptoms. Examine carefully for fluctuation, for surrounding œdema, and for leucocytosis, and these signs, when obtained, or the occurrence of shivers, or of remittent temperature, will render the diagnosis of abscess more certain. These abscesses may be in one of the compartments of the rectus sheath, or in either of the planes of cellular tissue in the abdominal wall, in the fatty tissue of the loin, in the peritoneal cavity shut off by adhesions, or occasionally in the retroperitoneal tissue. The position, outline, mobility, or fixity of the swelling, and its relation to resonant viscera, are the points to which attention must be paid in determining the site of the abscess.

Suppuration may occur between the liver or stomach and the diaphragm, and from its deep position its detection is attended with difficulty. For the diagnosis of the varieties of subphrenic abscess, *see* p. 587.

When, some time after an injury to the upper part of the abdomen, a swelling slowly forms which is dull on percussion, and is situated either above the stomach or between the stomach and transverse colon, as shown by the position of the dullness relative to the gastric and colonic resonance, it is a **pancreatic cyst**. The cyst is of the variety known as *pseudo-* or *traumatic cyst*, does not, as a rule, make itself apparent for some months after the injury, and may be accompanied by wasting and by increase of diastase in the urine.

When a swelling forms slowly and gradually in one of the lumbar regions after an injury in that situation, is unattended with fever, acute pain, or tenderness, and this swelling is found to fluctuate, a **rupture of the ureter**, with the formation of a **urinary cyst**, is to be diagnosed; and if, on tapping the swelling, watery fluid containing urea is drawn off, this diagnosis is confirmed.

III. **Abdominal wounds.**—In examining a wound of the belly the surgeon must determine whether it is limited to the parietes, or penetrates the peritoneal cavity; if the former, whether it is superficial, or extends through one or more of the muscular and deep aponeurotic layers; if the latter, whether there is protrusion or wound of any of the viscera, or wound of a blood-vessel; and, in all cases, whether any foreign body is lodged in the wound. Punctured wounds are those which generally present both the greatest difficulties in diagnosis and the greatest dangers, for their small external size often renders their exploration unsatisfactory, and they are frequently penetrating and complicated with wounds of viscera; bullet wounds partake of the same characters. Inquiry should always be made as to the manner in which the wound was inflicted, and the instrument used should be examined, to discover, when possible, how deeply it has penetrated, and whether it is entire, and also whether it is stained by stomach or intestinal contents.

1. **Is the wound penetrating?**—In some cases a wound is obviously non-penetrating, and in others, especially when punctured, it may be impossible to decide without enlarging it. The edges of an incision may be gently drawn aside, and its surfaces explored; when it extends only through the skin and superficial fatty tissue it is to be called a *superficial parietal wound*. When, however, it severs a muscle, or the muscular aponeurosis, and opens up the intermuscular planes or the sheath of the rectus muscle, or even still deeper fasciæ, the danger of subsequent hernia and of diffuse inflammation and suppuration renders it necessary to distinguish it as a *deep parietal wound*. Should there be any visceral protrusion, or the escape of the contents of any of the viscera (food, bile, fæces, urine), or if clear serous fluid or dark blood flows from the depth of the wound, and flows faster and with more force when the patient coughs or makes any effort, or should there be severe collapse or signs of internal hæmorrhage, hæmaturia, or hæmatemesis, or the passage of blood per anum, it is a *penetrating*

wound. When a doubt is entertained, the wound should be carefully enlarged and its depth and characters exactly determined.

2. **Is there protrusion of a viscus?**—This fact can be ascertained quite easily in the majority of cases: the omentum and small intestine are the viscera most commonly protruded; but the liver, stomach, spleen, and bladder may protrude.

All deep wounds must be carefully examined for protruding viscera. Where the protrusion is large there can be no difficulty whatever in recognizing it, although the possibility of a loop of intestine lying behind a fold of omentum must not be forgotten; a small protrusion of omentum between the lips of a wound may be overlooked unless care is taken. The omentum will be recognized by the granular arrangement of the fat, by the large vessels appearing on it, and by the fact that when it is gently pulled upon further prolapse takes place, and a distinct pedicle running from its deep surface is found. With ordinary care the smooth glistening surface of the intestine, stomach, and liver would be at once detected in a wound. It must be remembered that the urinary bladder when full may be protruded from a wound in the hypogastrium, even when the peritoneal cavity is not opened. In any case in which it is possible that the bladder may be thus protruded, a sterilized catheter should be passed and the urine drawn off; this will, of course, be followed by collapse of the vesical protrusion. Should a silver catheter be used, its extremity may be made to enter, and be felt in, the protrusion.

3. **Is there a wound of a viscus?**—(*a*) *Where there is protrusion of viscera,* all such protrusions should be carefully examined to see whether there

is any rupture or wound, as well as to remove any foreign bodies that may be adherent to or entangled in them. In the case of omentum and mesentery, note especially whether there is hæmorrhage from a wounded artery or vein. The collapse of prolapsed intestine and stomach, and the escape of their contents, gaseous or semi-solid, may at once indicate a wound; but the whole surface should be explored to see whether the peritoneum is torn, or whether there is at any spot a little projection of soft red mucous membrane, indicating a puncture of the gut; a larger wound of the intestine can hardly escape observation.

(*b*) *Where there is no protrusion* the surgeon may be left in doubt on the point. If undigested or partially digested food, unstained by bile, escapes from the wound, or if the patient vomits blood, a wound of the *stomach* is to be diagnosed; this lesion may be attended by severe collapse, and be followed by acute peritonitis. When fæcal matter escapes from the wound, or when blood is passed per anum, a wound of the *intestine* is clearly evidenced. When a wound is followed by the escape of urine, or by the occurrence of hæmaturia, it is the urinary apparatus that has been wounded, and the position of the wound, and the patient's power over his bladder, will determine whether it is a wound of the *kidney* or of the *urinary bladder*. Similarly, when bile escapes from a wound in the region of the liver, a wound of the *gall-bladder* or of one of the *bile-ducts* must be diagnosed.

When a wound is followed by syncope, deepening collapse, and blanching of the mucous surfaces, and especially if dark blood escapes from the wound, or if the belly is distended at any part, or there is dullness in the flanks, which may be noticed to increase, *internal hæmorrhage* is occurring. The position and direction of the wound will enable the surgeon to surmise the source of the bleeding; it may be the liver, the spleen, the vena cava, vena porta, or some other large abdominal vessel.

The absence of grave symptoms immediately after a penetrating wound of the abdomen is not a proof that the viscera are not injured. In the absence of such symptoms as have just been mentioned, the subject of a penetrating abdominal wound should be submitted to an exploration—through a separate incision in most cases—and all the viscera in the neighbourhood of the wound examined. The consequences of untreated vascular and visceral wounds are so grave that the surgeon should be prepared to demonstrate their absence rather than wait for conclusive evidence of their presence in the form of fatal collapse or infective peritonitis.

4. **Is a foreign body present?** — Foreign bodies are nearly always metallic and well shown in a skiagram. X-rays can be used to determine the presence and also the exact position of a foreign body. But treatment of a penetrating wound must never be delayed in order to obtain skiagrams.

IV. **Sequelæ of abdominal wounds.**—The sequelæ of wounds of the belly are—

Diffuse suppuration in the belly walls.
Peritonitis.
Fistula.
Artificial anus.
Hernia.
Adhesions.

When a wound of the belly wall is followed by considerable diffuse swelling of the tissues, with redness and œdema of the skin, pain, and tenderness, and the body temperature is raised, **diffuse inflammation** of the abdominal wall is proceeding, which, if not quickly subsiding, runs on to **suppuration.**

For the diagnosis of **peritonitis,** *see* p. 159.

Should the patient recover so far as the general results of the wound are concerned, but the wound through the belly wall remains open as a fistulous track, and through this the contents of any one of the abdominal viscera continue to escape, there is a **fistula.** If the discharge is unstained with bile, acid in reaction, and contains food unaltered, or but partly digested, it is a *gastric fistula,* or possibly a fistula in the upper part of the duodenum, above the entrance of the bile-duct. Should the discharge consist of the contents of the intestine, it is an *intestinal fistula.* When the matter escaping is soft, pultaceous, odourless, or nearly so, and of a light colour, the communication is with the small intestine; and when the discharge is distinctly fæculent, dark in colour, with a strong fæcal odour, and mixed with much gas, the communication is with the large intestine—*fæcal fistula.* In any case of doubt a careful chemical examination of the discharge, determining the presence or absence of pepsin, trypsin, or skatol, will show what part of the alimentary canal is wounded. Should the discharge be bile unmixed with chyme, or a watery fluid containing urea, it would be respectively a *biliary* or a *urinary fistula.* If, as the result of an operation, or of the natural separation of a slough of prolapsed intestine, the mucous membrane of the gut is immediately continuous with the skin, the intestine opening directly on the surface, it is an **artificial anus.** Should there be from such an aperture a soft, bright-red, corrugated projection, moistened with mucus, it is a *prolapse* of the artificial anus. But should there be from the aperture a smooth, rounded projection, covered by the same red mucous membrane, but reducible on gentle compression, leaving the mucous covering collapsed, it is a *hernia* at the artificial anus.

If a cicatrix in the belly wall is found to yield before the pressure of the abdominal contents, and a projection is formed at the spot, smooth, rounded, soft, with an expansile impulse on coughing, and tympanitic on percussion, it is a **hernia.** It may be reducible or irreducible; the coils of intestine are often visible through the thin cicatrix, or these and masses of omentum may be plainly felt. There is no distinct neck to the sac of such a hernia.

Wounds of abdominal viscera may be followed after a varying interval by symptoms pointing to the formation of **adhesions** between various portions of the intestinal tract. The diagnosis of this condition is considered at p. 582.

CHAPTER XIV

DIAGNOSIS OF INJURIES OF THE PELVIS

Injuries of the pelvis are generally the result of heavy blows or kicks, falls from a height, or severe crushing violence, or of gunshot wounds. They naturally group themselves into three categories: injuries of the soft parts covering the bones, injuries of the bones, and injuries of the contained viscera. The examination should be conducted with a view to determine into which of these categories the injury falls. The visceral injuries are, of course, very much the most serious.

Bruising of the soft parts will be recognized by the characteristic discoloration, the dull aching pain, and the swelling, which may vary in amount within very wide limits. Sometimes the ecchymotic discoloration extends over a very wide area, and then, by learning where it was first noted, some light may be thrown upon the seat of the lesion. Whenever the bruising implicates the perineum, scrotum, or penis, careful inquiry should be made whether there has been, or is, any hæmorrhage from the urethra. If a more or less clearly defined fluctuating swelling appears in the soft parts quickly after an injury, it is a **hæmatoma**; there may be no bruising of the skin over it; the blood may long remain fluid, or be quickly absorbed. Such swellings are most frequently found on the buttock.

As in other parts of the body, a contusion here may be followed by the formation of an **abscess**; this will be indicated by increasing swelling, pain, tenderness, redness of the skin, local œdema, and fluctuation; there will also be fever and leucocytosis.

Fracture.—To determine the presence of a fracture the examination should be carried out as follows: First place the hands one on each side of the symphysis pubis (the patient lying flat on his back), and run them along the bones from before backwards, and then down along the pubic arch, and observe if there is any irregularity in the outline of the bones. Next seize the iliac crest, or the anterior iliac spine, and try to move it on the rest of the bone; press the bone on each side of the symphysis pubis backwards, at first gently, and gradually more and more forcibly, and then, placing a hand on each side of the pelvis, press inwards. Lastly, notice whether pressure on the pubic spine is painful, and also whether the great trochanter of the femur of the one side is flattened or raised above the other (*see* p. 202); and whether movement of the hip-joint is painful.

If by this examination any marked irregularity in the outline of the pelvis, or mobility of any part of it, or crepitus, is detected, there is a **fracture of the pelvis**; by noticing the position of the irregularity and of the crepitus, and the part that is movable, the seat of the fracture may be made out. No distinction need be drawn between these fractures and separations of the pelvic synchondroses. Inability to stand, pain on all movements of the hip-joint, with great pain on pressing upon the pubic spine, are said to indicate a **fissure across the acetabulum.** But if, together with great pain on moving the hip-joint, there is distinct crepitus, there is **fracture of the acetabulum** with detachment of the fragments; while if, with these signs, the trochanter is found approximated to the middle line, it points to displacement of the head of the femur into the pelvis. (*See also* p. 206.) For the diagnosis of fracture of the sacrum and coccyx, *see* pp. 107, 109.

Whenever possible a good skiagram should be taken. It will show exactly the injury to the bone.

Injuries of the pelvic viscera.—The condition of the viscera must be next ascertained. Be careful to learn their condition before the injury, especially whether the bladder was full, and when it was last emptied; if a female, whether she was menstruating at the time, or pregnant, or whether she had been the subject of an abdominal tumour. Then ask what the patient's sensations at the time of the accident were, and note particularly any feeling of something "bursting" or "giving way." Inquire as to pain, its position, character, and time of onset, and whether there is desire to pass water or any tenesmus; particularly learn whether the patient has made any attempt to pass water, and if so, with what result, and whether any blood was passed, and notice whether any blood has flowed from the urethra independently of the act of micturition, or from the rectum, or vagina. And then observe the patient's general condition, whether or not it indicates shock or loss of blood. The entire absence of bruising of the skin is no proof that the viscera have escaped unhurt; extensive rupture of the bladder or of the uterus may occur without any external sign of so severe an injury.

As the urinary organs are those that suffer most frequently, the surgeon should consider them first.

If blood is found escaping, or is known to have escaped, from the urethra, and if there is bruising of the anterior part of the perineum, there is a **laceration of the urethra.** There is generally retention of urine, but occasionally it is found that the attempt to pass water has caused a sudden increase of the swelling in the perineum and scrotum—*extravasation of urine.* A catheter should now be carefully passed, and, if it reaches the bladder, clear urine will flow off: if this can be done, it shows that the urethra is not torn completely across; but if the surgeon fails to pass the instrument, and especially if its end is felt close under the skin, it is evident that the urethra is severed. This injury is usually the result of a fall across a beam, or some similar violence to the perineum.

If, as a result of a sudden strain, a patient experiences severe pain in one or other groin, and at the same time, or quickly after, bright blood flows from the urethra, but micturition is performed normally, and if the testicle on the same side becomes painful, tender, and somewhat swollen, and subsequently wastes, the accident is **rupture of the vas deferens.** The escape of blood from the urethra will at first suggest an injury of the urethra; but the nature of the accident (a strain, not a blow), the absence of bruising in the perineum and scrotum, as well as the normal performance of micturition, will exclude that lesion; the irritation and subsequent wasting of the testicle will establish the diagnosis.

The signs of **rupture of the bladder** vary considerably and are often ambiguous. If the patient is able to pass a full forcible stream of urine free from any admixture of blood, and without pain, it may be justly concluded that the bladder is not ruptured. Wherever there is any variation from this condition a rupture of the bladder should be suspected, and great care be taken to arrive at a correct diagnosis.

The accident only happens when the bladder is full, so the history is important. Rupture lessens the expulsive power of the bladder and may abolish it altogether; the viscus may be unable to hold fluid, or may retain a quantity varying from an ounce or two to a pint; the torn vessels in the bladder wall always bleed to some extent, and the urine passed or drawn off will contain more or less blood. If a large quantity of urine has escaped from the bladder, it can be detected either in the peritoneal cavity or in the pelvic cellular tissue. The patient may or may not show signs of shock; he may have a frequent desire to pass water, or there may be neither the desire nor the power to do so. At a varying time after the escape of urine from the bladder, inflammation, either peritonitis or pelvic cellulitis, is set up.

To arrive at a diagnosis, first determine, if possible, whether the bladder was full at the time of the accident; if it was, and now can be felt neither above the pubes nor by a finger in the rectum or vagina, that fact alone affords strong ground for the diagnosis. Then observe the act of micturition, the amount of urine passed and the force of the stream, and examine the urine for blood; the passage of much less than the expected amount, the loss of expulsive power, and the presence of blood, even if only a little, would be very significant signs. Pass a sterilized metal catheter, measure the quantity of urine drawn off, and notice whether it flows with the usual force or not. Having emptied the bladder, slowly inject a measured quantity—say one pint—of warm boiled water, and notice whether the bladder can be felt distended, and then measure the quantity of fluid that can be recovered through the catheter. Failure to distend the bladder, and to recover as much fluid as is injected into it, is very important evidence of a rupture. In some cases of rupture the end of the catheter will pass through the rent in the bladder and can be felt under the belly wall, or, having thus passed into the peritoneal cavity, will draw off from it a large quantity of fluid—urine and serum—different in character from that found in the bladder. A rupture of the bladder having been thus diagnosed, examine the flanks for shifting dullness which would show that the rent was *intraperitoneal*. If that sign is absent, notice carefully the state of the abdominal wall above the pubes and above Poupart's ligament (ligamentum inguinale): deep swelling there would be the sign of *extraperitoneal* rupture and extravasation of urine into the perivesical cellular tissue.

In the one case, *peritonitis* ensues after an interval; in the other, *pelvic cellulitis* with a gradually increasing swelling in the pelvis and lower abdominal wall.

The bladder may be ruptured not only in cases of fracture of the pelvis but also in cases of severe contusion of the lower abdomen, by muscular action, during parturition, by over-distension, or as the result of disease.

The diagnosis of *contusion* and *rupture of the pregnant uterus* and *rupture of an ovarian cyst* is discussed at p. 158.

Wounds of the pelvic viscera.—If urine flows from a wound of the penis or perineum during the act of micturition, it shows that there is a wound of the **urethra.** The escape of urine from a wound independently of micturition will indicate wound of the **bladder.** If there is an external wound of anus, or vulva, or vagina, or a history of a weapon of any kind having entered either of these canals, the finger must be passed gently into them, and their walls be carefully explored; a rent in either of them may in this way be found. With the aid of a speculum its extent and depth may be further appreciated. The onset of acute peritonitis will point to a wound of the **peritoneum**; if the bladder is found empty, or containing only a little urine and blood, it will indicate wound of the **bladder.** The small intestines may be found prolapsed into the vagina. The escape of blood and liquor amnii from the wound, or protrusion of part of the fœtus or of the placenta, and hæmorrhage into the vagina, indicate wound of the **pregnant uterus.**

Foreign bodies in the rectum or vagina will be detected on digital examination: when recently introduced, the history of the case will lead to their detection; when long impacted, the fact of a chronic muco-purulent discharge, with pain and, in the case of the rectum, tenesmus, will suggest the necessity for an examination.

Foreign bodies in the urethra.—If such bodies are in the spongy portion, they may be felt by passing the finger along the outside of the urethra, or they may be felt with a bougie, or seen with the urethroscope. If they are deeper in, the finger in the rectum may detect them; or, if not, on passing a full-sized silver catheter or bougie, obstruction will be met with near the neck of the bladder, and the foreign body may be pressed back into the bladder, and thus detected. It must not be forgotten that foreign bodies introduced into the urethra tend to pass spontaneously into the bladder.

Foreign bodies in the bladder.—In the absence of a definite history, a foreign body in the bladder is to be suspected if a child is seized with sudden retention of urine, or sudden pain on micturition with slight hæmaturia. A definite diagnosis can be made with either the cystoscope or X-rays.

Injuries of the penis, scrotum, and testicles.—Bruising of the skin is recognized by the usual signs: in the scrotum, especially, it causes considerable swelling and very dark discoloration, and the primary swelling from blood is increased by serous œdema. The thickness of the scrotum may then prevent a careful examination of the testicles. When there is great sickening pain immediately after the accident, with considerable collapse, and the testicle is found enlarged and exquisitely tender, the organ has been contused. *Contusion of the testicle* will be followed by the signs of *orchitis*, and later on by *atrophy* of the gland. A severe crushing injury may result in the testicle being pulped into a soft shapeless mass. An induration in any part of the penis immediately following an injury indicates *extravasation of blood into the corpus spongiosum* (*corpus cavernosum urethræ*) or *corpus cavernosum* (*corpus cavernosum penis*); if extensive and involving the whole organ, it may lead to extreme and even lasting priapism. The coverings of the penis and scrotum may be very extensively lacerated and displaced; for example, the entire covering of the penis and testicles has been known to be torn away, or the sheath of the penis may be drawn over that organ, which is then found lying deep in front of the pubes or in the scrotum—this has been called *dislocation of the penis*. One or both of the testicles may be torn quite away.

CHAPTER XV

DIAGNOSIS OF FRACTURES AND DISLOCATIONS OF THE UPPER LIMB

The application of X-rays to surgery has greatly simplified the diagnosis of injuries of the skeleton, not only by enabling us to see the bones and to detect the exact position of the articular ends, the lines of fracture, and the displacement of fragments, but still further by revealing fractures which are not recognizable by any other method of examination. In every case, therefore, in which injury of bones is suspected, an examination under the fluorescent screen, or, which is far more useful, the taking of one or more skiagrams, should be insisted upon. This examination should be made as soon as possible. Without the use of the X-rays a certain number of fractures are sure to be overlooked, and in every case the information afforded is of the greatest service to the surgeon.

In the large majority of cases the patient is able to point out the seat of injury; but this is not always the case, and the student must be particularly cautioned against omitting to examine all the parts of an injured limb, and all the limbs of a seriously injured person; for if not, when one fracture or dislocation has been detected, similar injuries or sprains and contusions may be overlooked, and the results be very serious.

Comparative measurement of the limbs.—It will be well to notice here the best measurements to take, and the injuries that modify them, before describing other methods of examination and the diagnosis of the injuries that may be met with. First, measure *from the inner end of the clavicle to the tip of the acromion:* this measurement is not increased by any injury; it may be shortened by fracture of the clavicle with overriding of the fragments, by bending of the bone (greenstick fracture), or by dislocation of its outer end. Next, measure *from the tip of the acromion to the outer epicondyle (epicondylus lateralis)* of the humerus, or *from the tip of the coracoid process to the inner epicondyle (epicondylus medialis)*: if lengthened, there is a dislocation of the shoulder. Shortening of the arm, as shown by this measurement, may be caused by dislocation of the shoulder, by fracture of the humerus, or by fracture with displacement downwards of either the acromial or the coracoid process. Then measure *from each epicondyle of the humerus to the styloid process* of the same side: shortening of the outer line may be caused by dislocation of the radius at the elbow, or by fracture of the same bone; shortening of the inner line is similarly due either to dislocation or fracture of the ulna. In the wrist and hand, measurements may be taken *from the tip of either styloid process to the base of the first and fifth metacarpal bones* respectively: shortening of this measurement indicates a dislocation of the wrist. A useful measurement is the *circumference of the shoulder*, taken by passing the tape under the axilla, and bringing its ends vertically up over the shoulder: dislocation of the joint increases this measurement by from one to two inches. The distance between *the tip of the olecranon and either epicondyle* of the humerus indicates the relative position of the ulna to these bony points.

Examination of clavicle and scapula.—The patient should be seated in a chair, and the surgeon, standing behind him, should place the forefinger of each hand on the suprasternal notch of the sternum, and, passing outwards, he should feel on either side the large inner end of the clavicle, noting whether the two are symmetrical or not; he should then run the ends of his fingers along each clavicle to the point of the shoulder, and along the acromion and spine of the scapula to the posterior border of that bone, all this arch of bone being subcutaneous. Comparing the two sides, he observes particularly any break in the line of the clavicle or scapula, and any tender spot in the bony arch.

The fingers should then be passed along the vertebral border of the scapula to the angle, and the angle should be seized in the hand and an attempt made to move it on the rest of the bone. When the arm is raised from the side the axillary border of the scapula can be examined in the same way. The acromion process and the spine of the scapula can be seized and tested for mobility and crepitus. The coracoid process can be felt in the groove between the pectoralis major and deltoid, just under cover of the deltoid; it should be noticed whether it is depressed or movable. One hand should now be laid on the top of the shoulder, and the elbow grasped in the other hand, and while upward pressure is made the limb should be rotated to ascertain if crepitus can be felt.

By this examination the inner end of the **clavicle** may be found to be *dislocated* either upwards, forwards, or backwards. When the bone is dislocated behind the manubrium there may be very great distress from pressure upon the trachea, œsophagus, or the great vessels and nerves of the neck.

If the line of the clavicle is interrupted, or if crepitus can be felt in it, there is a *fracture*. This is most common in the middle third, with considerable deformity; it may occur close to the inner end, with slight deformity, or at the outer end between the conoid and trapezoid ligaments, without any deformity: this fracture is recognized by the local tenderness and crepitus on rotating the arm. An unsymmetrical, exaggerated anterior curve is due to a *greenstick fracture* of the clavicle; the bone will be tender. Rickets causes a similar curve, but it is symmetrical.

The acromion process of the **scapula** may be found *dislocated* below, or more rarely above, the outer end of the clavicle; the slight and symmetrical ridge which normally marks the joint must not be mistaken for dislocation of this joint. The tip of the acromion may be found *broken* off and drawn down by the deltoid, or the whole process may be broken across at its root, movable and giving crepitus: if the crepitus is soft it indicates a *separation of the epiphysis.*

Irregularity of the bone, mobility and crepitus, may show *fracture* of the *spine* or *body* of the scapula; and if the *coracoid process* is lower down than normal, and movable, it is evidently *fractured*; if the crepitus is soft and the patient young it would indicate *separation of the epiphysis.*

Examination of the shoulder.—The surgeon, standing in front of the patient, should place his hand flat upon the outer part of the patient's shoulder, with his thumb resting on the acromion; if he feels the upper end of the humerus beneath the deltoid muscle, projecting beyond the acromial arch, the head of the bone is in the glenoid fossa—*there is no dislocation.* If the resistance is not felt, but the hand sinks in deeper than the acromion towards the glenoid fossa, the *shoulder is dislocated.* When comparing the two shoulders the possibility of a bilateral dislocation must be borne in mind.

Dislocations of the shoulder.—In all dislocations the anterior fold of the axilla is depressed and the circular measurement over the shoulder and under the axilla is increased, and a ruler or some such body can be made to lie with one end on the external epicondyle of the humerus, the other against the acromion. To determine the variety of dislocation present, the head of the humerus must be sought. It will be recognized by its rounded contour, and by its rolling under the hand when the elbow is rotated ; the direction of the arm will give a good clue as to the position of the bone ; the farther the arm is abducted from the side the lower down is the head of the bone, and if the elbow is behind the transverse median plane of the body, the head of the humerus is in front of it, and vice versa. The head of the humerus should first be felt for in front, filling out the groove between the deltoid and pectoral muscles, obscuring the coracoid process, and forming a rounded prominence, moving when the arm is rotated ; if it is found there, the dislocation is *subcoracoid.* Some would draw a distinction between subcoracoid and intracoracoid ; in the former the arm is rotated out, in the latter the arm is rotated in.

If on examining the front of the shoulder the tip of the coracoid process can be plainly felt, and the head of the bone is felt in the axilla, bulging down its floor, the dislocation is *subglenoid.* Subcoracoid dislocations are often mistaken for subglenoid, owing to the ease with which the misplaced bone can be felt in the axilla when the arm is raised. A subglenoid dislocation is rare, and is only to be diagnosed when there is a distinct interval between the coracoid process and the head of the humerus, and when the whole globe of the head can be readily felt in the axilla.

If the head of the bone is found lying below the clavicle internally to the coracoid process, and out of reach of the fingers passed into the axilla, the dislocation is *subclavicular*. If the head of the humerus cannot be found in front, feel for it behind, below the acromion and spine of the scapula; if detected there, it is a *subspinous* dislocation.

If the head of the humerus is found forced up under the skin between the deltoid and pectoral muscles, forming a very marked and unmistakable projection on the top of the shoulder, it is a *supra-coracoid* dislocation; this is always associated with fracture of the acromion or of the coracoid process. It is occasioned by severe violence applied to the elbow forcing the humerus upwards against the scapula.

If the arm is placed vertically upwards by the ear of the same side, and the head of the bone is projecting the floor of the axilla in the same position as in a subglenoid dislocation, it is the rare form known as *luxatio erecta*.

If, in reduction of the dislocation, crepitus is obtained, and the head of the bone easily slips out of place again, and the surgeon is able to assure himself that there is no fracture of the humerus or of the coracoid or acromion process, he should diagnose a *fracture of the glenoid cavity*. This injury is never met with apart from dislocation of the joint, except as the result of gunshot wounds.

Fractures of the shoulder.—The surgeon, having decided that the upper end of the humerus occupies the glenoid cavity of the scapula, must carefully examine the outline of the upper end of the humerus, and then try whether there is mobility in the length of the bone, or crepitus.

The outline of the upper end of the humerus can be felt through the deltoid muscle, and the fingers in the axilla can examine the inner side of the neck of the bone. To detect crepitus, place one hand on the outer side of the shoulder and rotate the elbow with the other hand. By this means one may not only detect crepitus and be sure that there is a fracture, but may notice that the upper end of the bone does not rotate with the lower end, and so demonstrate a solution of continuity in the bone. The greater tuberosity, too, should be grasped to see if it is movable on the shaft of the bone.

By this examination it may be found that the *great tuberosity* (*tuberculum majus*) is *fractured*, or that there is a *fracture* of the *neck of the humerus*, either at its anatomical or its surgical neck. The head of the humerus may be felt loose in the axilla, not moving with the shaft, showing that there is a *fracture of the neck with dislocation of the head* of the bone. If the patient is under 20 years of age, and a projection of the upper end of the humerus is found in front just below the coracoid process, and rotation of the arm causes a soft kind of crepitus, it is *separation of the upper epiphysis of the humerus*. If the upper end of the humerus is a little deformed, the shoulder a little flattened, but the bone moves all in one and without crepitus, there is an *impacted fracture of the neck*. This injury is sometimes followed by a gradual downward displacement of the head of the bone, so that the upper end of the bone may be in the glenoid fossa and the head be felt projecting in the axilla below the socket.

If, on rotating the arm, deep crepitus is felt, and yet the humerus is entire, there is a *fracture of the neck of the scapula;* the coracoid process may or may not be detached from the body of the bone and move with the arm. In this accident the shoulder will be flattened, the elbow dropped, and it will be noticed that by propping up the elbow the arm is raised and the flattening of the shoulder is corrected.

If there is a point of great tenderness on the great tuberosity, and the patient is unable to abduct the arm with the palm of the hand to the front, whilst he is able to do so if the arm is rotated either in or out, there is complete or partial *separation of the tendon of the supraspinatus muscle* from its attachment to the great tuberosity.

If the head of the humerus occupies the glenoid cavity and no fracture can be detected, and the arm is fixed in the abducted position, but when the surgeon flexes the elbow and rotates the arm he feels something slip, and then finds the deformity corrected and all the rigidity gone, the condition is *dislocation of the tendon of the biceps* from the bicipital groove (sulcus intertubercularis).

Fracture of the shaft of the humerus.—The shaft of the humerus can easily be felt by running the fingers and thumb down its inner and outer sides, and by testing it for mobility and crepitus. Fracture usually causes marked deformity in the arm (often an angular bend forwards or to one side), as well as mobility in the length of the bone, and crepitus. Care must be taken to ascertain not only the exact position of the fracture, but particularly the direction in which the displacement occurs, and whether there is comminution of the bone. The vessels and nerves of the arm lie so close to the bone that they are liable to be injured both by the fracturing force and by projecting angles of the bone. The surgeon should be careful to compare the radial pulse on the two sides, and to notice whether there is any anæsthesia or paralysis of the forearm or hand.

Fractures and dislocations of the elbow.—The varieties of fracture and dislocation about the elbow-joint are numerous, and their diagnosis is extremely important, for, unless all displacement is corrected, the function of the joint may be permanently interfered with. The fractures are commonly the result of direct violence, so swelling comes on quickly, and greatly adds to the difficulty of diagnosis by obscuring the outline of the bones. When X-rays cannot be used it is often necessary to give an anæsthetic, so that a careful and complete examination can be made. By comparing the two elbows the surgeon must first determine whether the relation of the bony points is altered, and then whether there is mobility in the length of either of the bones. The best way to examine the elbow is to stand in front of the seated patient and, grasping the two elbows in the palms, place the thumbs on the external (lateral) epicondyles, the middle fingers on the internal (mesial) epicondyles, and the forefinger tips on the points of the olecranon processes. The relative position of these three bony prominences is first to be ascertained. When the joint is flexed the olecranon sinks below the epicondyles; when the elbow is extended it lies in a line with them. Having observed whether the relation of these three bony points is altered or unaltered on the injured side, the surgeon should next feel for the head of the radius; it should be found lying immediately below the external epicondyle, and rolling under the finger when the wrist is pronated and supinated. If not found in its normal position it should be felt for in front of, behind, or on the outer side of the condyle. Next, each condyle should be seized and an attempt made to move it on the rest of the humerus, and if movement is obtained the size of the detached fragment should be determined. The outline of the olecranon should be felt, and, this point of bone being grasped, it should be tested for transverse mobility on the ulna—fracture of this bone is often overlooked. The distance between the two condyles can be measured by calipers; any increase in it immediately after an injury must be due to fracture of the humerus. Then notice whether the elbow is rigid or movable—rigidity is the common result of dislocation, whereas in a fracture movement is possible but almost always causes a good deal of pain.

By this examination the following injuries can be recognized: 1. When the olecranon projects too far behind both condyles of the humerus and the sigmoid notch can be felt, there is *dislocation of the ulna backwards*, and if at the same time the head of the radius is felt behind the outer condyle there is *dislocation of both bones backwards;* but the head of the *radius* may be found displaced *in front of the capitellum.* If when the dislocation is reduced it recurs at once, it is probable that the *coronoid process of the ulna is also fractured.* The fragment of bone may possibly be felt in front of the joint, or there may be crepitus.

2. The two bones of the *forearm* may be *dislocated inwards* or *outwards;* in either case one of the epicondyles of the humerus will be very prominent, and a bone of the forearm will project on the opposite side of the joint.

3. If the prominence of the olecranon at the back of the joint is lost and the head of the radius

is felt in front of the capitellum (capitulum), there is *dislocation of both bones forwards*; in this case the distance between each epicondyle and the styloid process is increased.

4. Although the olecranon maintains its normal relations with the condyles, the head of the *radius* may be found *dislocated forwards, backwards*, or *outwards*. In the forward displacement of the bone, flexion of the elbow is brought to a sudden stop by contact of the radius with the front of the humerus. So long as the ulna is articulating with the trochlea, flexion and extension of the joint can be obtained. In young children, forward dislocation of the radius caused by pulling on the forearm is common, and is known as *pulled elbow*.

5. If the olecranon is unduly prominent at the back of the joint, but the distance between its tip and the outer epicondyle is unaltered, and the sigmoid notch (incisura ulnaris) cannot be felt, there is *separation of the lower epiphysis of the humerus*, with displacement backwards. The deformity will be corrected by drawing forwards the forearm, and will be attended with soft crepitus; flexion of the joint is possible. The inner epicondyle may or may not be detached with the rest of the epiphysis—if it is not, the distance between it and the olecranon is increased, as in backward dislocation of the ulna. This injury occurs only in children and youths.

6. The *olecranon* or either of the *epicondyles of the humerus* may be found movable and grating, owing to *fracture*. The detached fragment in either case may be a mere scale of bone, or the whole projecting process, or may include a part of the shaft of the bone.

7. The elbow may be found unduly prominent posteriorly, and the relative positions of the olecranon

and condyles unaltered, showing that there is no dislocation, but the line of the humerus is deformed just above the joint, and on attempting to draw forwards the forearm crepitus is felt, and the deformity becomes lessened. This shows a *fracture of the lower end of the humerus*, with displacement backwards. If the crepitus is very marked and easily obtained, and especially if one epicondyle can be moved independently of the other, there is a T-*shaped fracture into the joint.*

8. When on rotating the forearm the head of the radius does not move, and crepitus is felt just below it, there is a *fracture of the neck of the radius.*

9. If on rotating the forearm crepitus is felt just below the outer epicondyle, and is also elicited by pressure on the head of the radius, and especially if any part of this bony process is felt to be movable, it will be evidence of *fracture of the head of the radius.*

10. If the presence of crepitus on moving the elbow shows that there is a fracture, but all the bony points of the joint are in their normal relation and cannot be moved independently, and further if there is a deviation in the line of the limb at the elbow-joint, or a lateral movement there with crepitus, a *fracture of the articular process* of the humerus may be diagnosed. This injury is very rare.

Fracture of forearm.—Either of the bones may be broken singly, but fracture of the two bones together is more common; "greenstick fracture" is more frequent in this situation than in any other. The signs of fracture are the common ones of pain, swelling, deformity—usually very marked—mobility and crepitus. The posterior edge of the ulna is subcutaneous in its whole length, and may therefore be easily examined; the continuity of the radius may be shown by observing whether the head of the bone follows the movement of the wrist in pronation and supination.

1. If the bones are bent, but there is neither mobility in the length of bones nor crepitus, the injury is a *greenstick fracture.* This injury only occurs in children.

2. An angular deformity of the forearm, with mobility in its length and crepitus, will indicate *fracture of the radius and ulna.*

3. Or either bone may be found broken singly. In this case there will be little if any deformity, but there will be a very painful and tender spot in the shaft of one bone with mobility and crepitus just there.

Fractures and dislocations of the wrist and hand.—The bones of the wrist being subcutaneous, any displacement of the joints or fracture with displacement of the fragments is easily detected by the eye and by the hand. But the X-rays have taught us that many *sprains* of the wrist are associated with fracture of a bone *without displacement.*

Notice particularly the relative positions of the styloid processes of radius and ulna, the line of the inner side of the wrist, whether the lower end of the ulna is unduly prominent and has a dip below it; also the outline of the lower end of the radius and the plane of the hand and forearm. Slight impaction of the lower end of the radius may be overlooked unless care is taken to observe these points: it always causes raising of the radial styloid process (radial shortening) and displacement of the hand to the radial side (radial abduction), making the ulnar styloid stand out. The bones of the fingers and thumb are all practically subcutaneous on the dorsum; the surgeon should, therefore, run his fingers along the dorsum of the metacarpal and phalangeal bones, and note any deformity, and any loss of prominence of either of the knuckles, and then, grasping the extremities of each bone, one in either hand, should see if there is any mobility with crepitus. He should notice also if there is any lessening of the mobility at any of the joints.

The injuries that may be met with are the following:

1. If the styloid process of the radius is on a level with or above that of the ulna, there is a *fracture of the lower end of the radius.* The lower fragment is almost invariably displaced backwards and to the radial side, causing more or less of a prominence on the back of the wrist above the styloid process of the radius, and a corresponding hollow on the palmar aspect, and the styloid process of the ulna appears too prominent, with a marked groove or depression below it. This is the commonest accident in this region, and is known as *Colles's fracture* (Plate I.). The fracture is usually impacted, and mobility and crepitus are not obtained. The amount of deformity depends upon the extent of the impaction: it may be very slight or strongly marked. If this deformity is met with in a young person under 18 or 20 years of age, and it is reduced with a soft grating sensation on extension of the hand, it is a *separation of the lower epiphysis of the radius.*

2. If there is a prominence just above the dorsum of the wrist, and the whole hand is carried back, but is in a straight line with the forearm (not abducted), the injury is a *fracture of the lower end of the radius and ulna.* In this fracture there is generally mobility and crepitus, and the break in the line of the ul

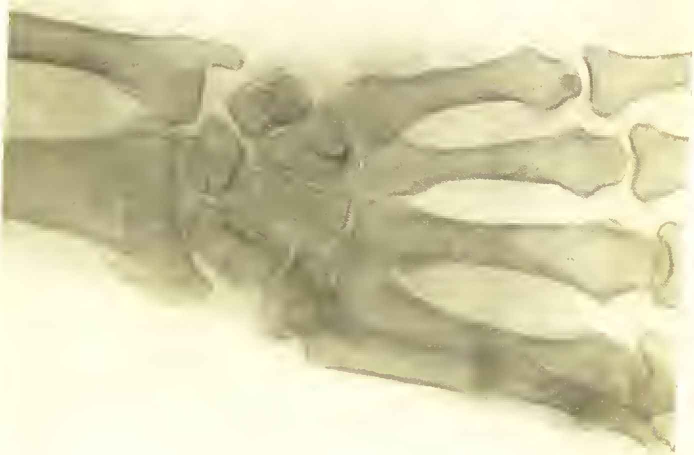


Fig. 1.—Colles's fracture : Antero-posterior.

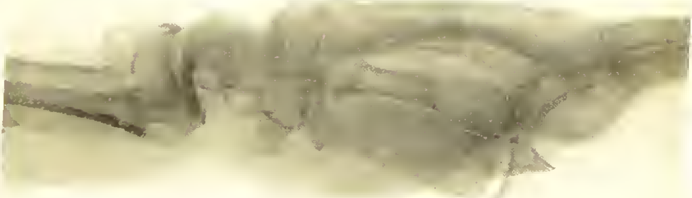


Fig. 2.—Colles's fracture : Lateral.

PLATE I.

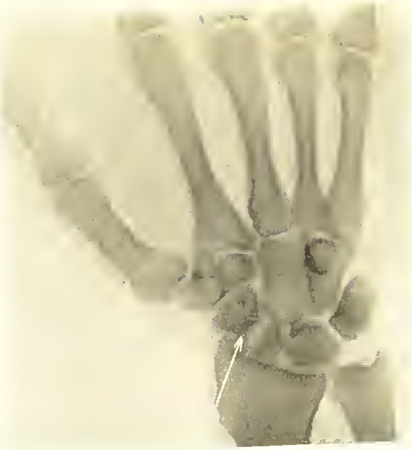


Fig. 1.—Fracture of scaphoid bone of carpus.

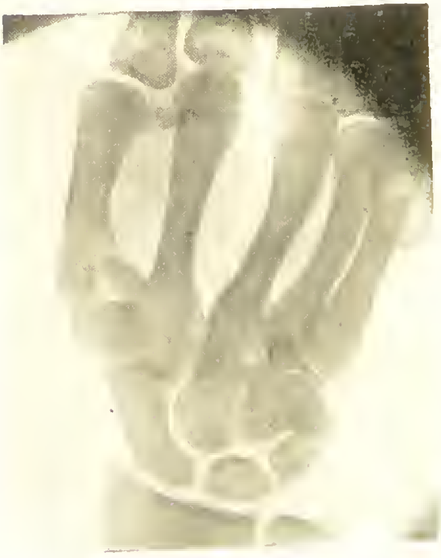


Fig. 2.—Bennett's fracture of thumb.

PLATE II.

is obvious; the distance between the epicondyles and the styloid processes is, of course, shortened.

3. If, while the styloid processes keep their normal relation to each other, the distance between either styloid process and the base of the metacarpus is considerably shortened, the injury is a *dislocation of the carpus*. The convex upper border of the carpus will be felt as a prominent swelling on the back or on the front of the wrist. This injury is very rare.

4. If the lower end of the radius is very prominent on the back of the wrist, lying over the end of the ulna, it indicates *dislocation of the lower end of the radius backwards*. Should the prominence on the back of the wrist be formed by the lower rounded end or head of the ulna, which is very prominent under the skin, resting on the radius, it is a *dislocation forwards of the lower end of the radius*. These dislocations are both of them quite uncommon; they are sometimes spoken of as dislocations of the ulna in the opposite direction. In either case the length of the forearm, and the distance between the styloid processes and the bones of the metacarpus, are unaltered. Pronation and supination of the hand are very limited and painful.

5. Pain in moving the wrist, persisting for some time and attended by swelling on the front and back of the joint without deformity, may be due to a *sprain of the wrist*, or a sprain plus (*a*) a fissure of the lower end of the radius, (*b*) fracture of one or other styloid process, or (*c*) fracture of a bone of the carpus, most commonly the scaphoid bone (os naviculare). These injuries can only be detected and differentiated by X-rays. And since an exact diagnosis has an influence upon treatment, the surgeon must not delay the taking of a skiagram [illegible]

until delay in recovery raises a suspicion of some injury more serious than a sprain. (Plate II., Fig. 1.)

6. A carpal bone, either the semilunar (os lunatum) or less commonly the os magnum (os capitatum), may be dislocated forwards on to the carpus; more rarely backwards. This injury is accompanied, as a rule, by a fracture of the scaphoid bone (os naviculare).

7. *Dislocation of a metacarpal bone or phalanx* is recognized by the deformity at the joint and the lessened mobility of the part.

8. *Fracture of metacarpus or phalanx* is recognized by deformity, mobility, and crepitus in the length of the bone. Slight deformity with tenderness, but without movement or crepitus, indicates a green-stick fracture of a metacarpal bone or phalanx.

9. Pain, deformity, crepitus at the outer side of the base of the thenar eminence, denote a fracture of the base of the first metacarpal. When the fracture involves the articular surface, it is known as *Bennett's fracture* or *stave of the thumb*. (Plate II., Fig. 2.)

10. *Mallet finger* is a condition in which the patient is unable to extend the terminal phalanx, which hangs in the flexed position, and is due to rupture of the insertion of the extensor tendon into the base of the phalanx.

CHAPTER XVI

DIAGNOSIS OF FRACTURES AND DISLOCATIONS OF THE LOWER LIMB

A LARGE proportion of the fractures and dislocations of the lower limb are at once recognized by the obvious deformity they occasion; in others the seat of pain marks the position of the injury, and the detection of crepitus enables the surgeon to diagnose a fracture; only in a minority of cases is there grave difficulty in arriving at a conclusion as to whether a patient has sustained a fracture or a dislocation, and these are mainly met with in injuries of the hip-joint, where the difficulty arises from the thickness of the soft parts. But in these cases, and in fact in all suspected or actual injuries of bones, the information to be obtained from a good skiagram is so exact as usually to render a detailed clinical examination unnecessary. We do, in fact, rely to-day almost entirely upon X-rays for our diagnosis, wherever they are available, and the student will appreciate that much of what follows in this chapter applies only to those cases where for some reason their help cannot be obtained.

In examining the injured limb, the surgeon should first of all expose the two limbs completely, and look carefully to see if there is any deformity, any alteration in the line or position of the limb or of any of its parts, or any unusual swelling, prominence, or depression, or obvious alteration in its length, the existence of which will indicate not only the fact of a lesion of the skeleton of the part, but its situation, and in many cases its nature. Next, the limb should be examined with the hand, and the outline of the bones and their relative positions compared with those of the sound limb. Movement in the length of the bone and crepitus are to be tried for, and the freedom of movement at the joints is to be tested; the seat of pain and tenderness is to be examined with special care.

A comparison of the following **measurements** n the two limbs is of great importance in the diagnosis of injuries of the lower limb:

1. **The length of the limb from the anterior superior iliac spinous process to the tip of either malleolus.** It is necessary to have the patient lying with the pelvis straight, that is, with a line between the two anterior iliac spines crossing the median vertical plane at right angles. The surgeon must also be very careful to take the measurement from exactly the same point of the spine of the ilium on the two sides. Mistakes may easily be made in fat persons, and the best safeguard is to pass the finger on to this point of bone from below. This measurement gives the length of the entire limb; alterations in it afford no guide as to the site of a lesion, which may be in the hip, thigh, knee, or leg. Inequality of the measurement on the two sides may be due to a recent injury, to congenital asymmetry, or to previous injury, operation, or disease. The last three will generally be indicated by a scar, by wasting, or by paralysis, and the patient will be aware of the fact; but he may be quite unaware of congenital inequality of the limbs. Congenital asymmetry affects equally the thigh and the leg, but asymmetry due to injury affects

only the injured part. With the double object of excluding congenital asymmetry and of localizing the injury, the thigh and the leg should next be measured separately.

2. The **length of the thigh** is ascertained by taking the distance from the anterior superior spine of the ilium to the upper border of the patella; or from the pubic spine to the adductor tubercle of the femur. Some prefer to take the lower border of the patella as the lower point. If the patella is taken, care must be used to ensure that the knee-joint is in the same position in the two limbs, and the bone should be pushed up to its full extent. This measurement is shortened by the conditions which modify the vertical position of the trochanter, and, in addition, by fracture of the shaft of the femur with over riding of the fragments, and by dislocation upwards of the patella, and, when the top of the patella is taken as the lower point, by transverse fracture of the patella, with separation of the fragments.

3. The **length of the leg** is best measured from the upper edge of either tibial condyle to the tip of the malleolus on the same side. The upper edge of the tibia is felt more easily when the knee is flexed. This measurement is shortened in oblique fracture of the tibia and fibula, and in fracture of the lower end of the bones with vertical displacement.

4. The **distance between the front of the head of the fibula and the tubercle of the tibia** (tuberositas tibiæ) will show whether the head of the fibula is occupying its right position on the outer tuberosity of the tibia.

The seat and character of pain, functional disturbance in the limb, resistance to passive motion, or a sudden "slip" and setting free of a joint, as well as the history of the accident, and the age of the patient, are points which give important aid in diagnosis. Children are very liable to transverse fracture of the shaft of the femur, as well as to separation of epiphyses; greenstick fracture is much rarer in the lower limb than in the upper. Elderly women are liable to fracture of the neck of the femur from slight indirect violence. Dislocation of the hip is caused by violent abduction of the joint, and occurs more often in men than in women. Diastasis results from indirect violence, often combined with rotation; oblique and spiral fractures are the result of indirect violence with twisting. Efforts to save from falling are liable to cause transverse fracture of the patella. Pott's fracture results from eversion of the foot, as in slipping from the kerb on to the inner edge of the sole. Dislocations of the knee and the various displacements and fractures about the ankle are caused by severe violence, such as falls from a height. Injury of a semilunar cartilage is caused by twisting the knee when it is partly flexed and the foot is fixed.

Examination of the hip.—Notice first the *position of the limb,* whether everted or inverted, flexed or extended. Fracture of the upper end and shaft of the femur always causes eversion, the common dislocation causes marked inversion; in fracture the thigh is extended, in dislocation it is more often flexed. Next, place the hands flat upon the outer side of the hips and feel for the trochanters, noticing whether these prominences are symmetrical, especially whether on the injured side the trochanter is raised nearer to the iliac crest or not, whether it is more, or less, prominent than on the sound side, farther forward or farther back, and whether its outline is altered and the bone tender. The *relation of the great trochanter to the pelvis* is of the utmost importance in the diagnosis of dislocations of the hip and fractures of the neck of the femur; it should be determined accurately by one of the following methods:

Nélaton's line.—Draw a line from the anterior superior iliac spine over the outer side of the hip to the prominence of the ischial tuberosity. The top of the great trochanter should just touch this line in every position of the joint. By this line we can determine whether the trochanter is above or below its normal position. The length of the line in front of the trochanter gives roughly the horizontal position of the bone.

Bryant's line. — With the patient lying flat on his back, draw a line vertically down to the bed from the anterior superior iliac spine, then draw a second line from the top of the great trochanter to join the first line at right angles; the length of this second line marks the vertical distance of the top of the great trochanter below the front of the iliac crest. This measurement gives us the same information as Nélaton's line, but it is obtained without any movement of the patient, and therefore without inflicting any pain or damage.

If a third line is drawn from the front of the iliac crest to the trochanter, it forms a triangle, and the length of this third line gives roughly the horizontal position of the trochanter.

Morris's bitrochanteric test.—By means of a graduated rod along which move two pointers, the distance of the outer border of the trochanter from the mid-line of the body can be accurately measured In most dislocations of the hip this distance is diminished.

Feel now in the groin for the normal resistance of the *head of the femur*, and if the groin is very hollow, allowing the fingers to sink in towards the acetabulum, feel for the globular head in the buttock. It is useful to remember that in an unbroken femur the inner surface of its inner condyle always looks in the same direction as its head, and this fact enables us to tell in which direction the bone has slipped in cases of dislocation of the hip.

Next, test *the movement* at the hip; it is best to get an assistant gently to flex the joint, and to rotate it in and out while the surgeon keeps his hand flat over the trochanter. Rigidity of the joint will be appreciated, and crepitus may be felt. It is sometimes noticed that the trochanter rolls round in a smaller circle on the injured side; if the fracture be impacted the head of the femur can also be felt rolling with the shaft of the bone.

In any injury of the thigh causing shortening or approximation of its two attachments the ilio-tibial band is relaxed. To examine for this the fingers should be pressed in horizontally above the great trochanter or above the outer condyle of the femur.

Lastly, the trochanter may be grasped and a careful attempt made to move it apart from the rest of the femur. All these movements must be made gently, lest an impacted fracture be disimpacted.

Fracture of the neck of the femur.—Eversion of the limb and loss of power in it are the two leading signs of fracture of the neck of the femur: only very rarely is the limb found inverted; the diagnosis of fracture rests upon finding the trochanter raised and the limb shortened while the head is in its normal position. If in a patient under 20 years of age there is, immediately after an injury to the hip, eversion of the limb, with raising and flattening of the trochanter, and prominence of the bone in Scarpa's triangle, there is a *separation of the upper epiphysis of the femur.*

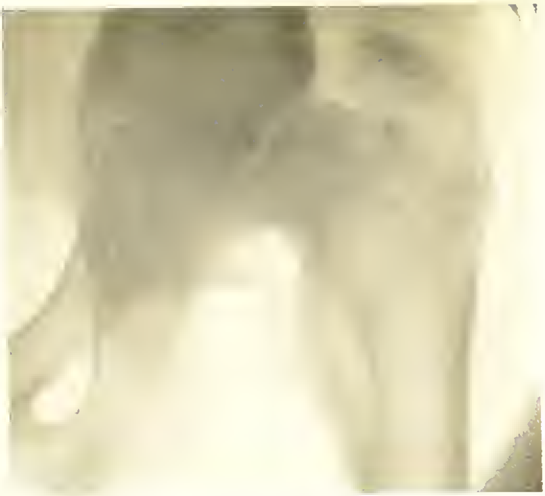


Fig. 1.—Intracapsular fracture of femur.

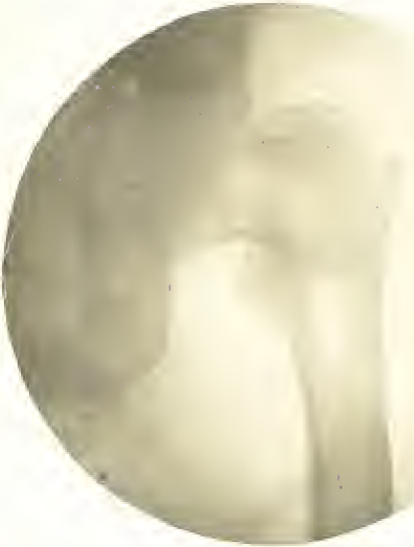


Fig. 2.—Extracapsular fracture of femur.

PLATE III.

(Knox's "Radiography and Radio-Therapeutics.")

If the head of the femur is felt in the acetabulum moving with the shaft of the bone without crepitus, and the trochanter is unaltered in outline and position, there is neither fracture nor dislocation; but a severe *contusion* may cause the limb to be everted. This injury may be followed by gradual shortening of the limb and raising of the trochanter from absorption of the neck of the bone. From the great pain, the loss of power, and the eversion of the limb, this injury simulates a fracture, and the subsequent shortening makes the resemblance still closer. When the patient is already the subject of *rheumatoid arthritis*, which has led to shortening of the limb and some deformity of the trochanter, it is impossible to diagnose a contusion of the soft parts from an impacted fracture of the neck of the bone, unless the surgeon is aware of the previous condition of the joint, except by the use of X-rays.

If the trochanter is raised and its rotation causes crepitus, there is an unimpacted *fracture of the neck of the femur*, often called an *intracapsular fracture.* (Plate III., Fig. 1.) The trochanter may be felt to rotate on its own axis instead of round the arc of a circle; the outline of the bone is unaltered.

If the trochanter is raised and the head of the femur moves with the shaft and there is no crepitus, there is an *impacted fracture of the neck of the femur*, or an *extracapsular fracture.* (Plate III., Fig. 2.) Deformity of the trochanter, especially an apparent increase in size, may be caused by the neck of the bone being driven into it and splintering it. The former injury, viz. intracapsular fracture, is the result of indirect violence, and usually is met with in elderly patients. Extracapsular fractures, on the other hand, are caused by direct violence, and are met with most commonly in vigorous adults.

Should the trochanter be found much flattened, sunk in towards the middle line, and movement causes deep crepitus, it indicates *fracture of the acetabulum* with the head of the femur driven into the pelvis. The finger in the rectum or vagina will be able to feel the projection into the pelvis.

If the great trochanter is found to be movable, there is a *fracture of the great trochanter*; if these signs are found in a child under 16 years of age they indicate a *diastasis of the great trochanter.* The separated trochanter may be raised, but the limb is not shortened; there may or may not be crepitus. This injury is very rare

Dislocations of the hip.—When the absence of the normal resistance caused by the head of the femur in the groin, and the great rigidity of the joint, show that the femur is dislocated, the diagnosis must be completed by finding where the head of that bone is lying.

If the limb is inverted, feel for the head of the bone behind the acetabulum; if the trochanter is raised one to two inches, and the head of the bone is felt behind it, beneath the glutei muscles, it is *dislocated on to the dorsum ilii*; but if the trochanter is raised only an inch, and the head of the bone is very indistinctly felt, and is only very slightly movable, it is *dislocated into the sciatic foramen* (*incisura ischiadica major*). If the thigh is a little shortened and strongly inverted, and also adducted and behind its fellow, it indicates that the head of the *bone is* "*strapped down by the great sciatic nerve.*" If the limb is greatly flexed, adducted, and inverted, the thigh being (possibly) in contact with the belly, and the head of the bone is felt above the prominence of the ischial tuberosity, there is a *dislocation on to the tuber ischii.* This is a very rare form of dislocation backwards; the trochanter may be found a little below or a little above its normal situation, according to the distance the head of the femur has passed back.

If the limb is everted, the head of the femur may be found deep under the adductor muscles—*dislocation into the thyroid foramen*; or on the pelvis, filling out the hollow of the groin—*dislocation on to the pubes*; or beneath Poupart's ligament (ligamentum inguinale), close to the anterior inferior iliac spine—*subspinous dislocation*; or close in front of the anterior superior iliac spine—*supraspinous dislocation*; or bulging beneath the skin of the perineum—*dislocation into the perineum*. The head of the bone may be found on the dorsum ilii, with the trochanter still farther back and the thigh abducted—*everted dorsal dislocation*.

In these various dislocations with eversion, the position of the limb as regards both abduction and flexion and the amount of shortening vary much, but the diagnosis of the varieties depends entirely upon identifying the actual position of the displaced bone.

If on reduction of a dislocation the head of the bone readily slips out of place again and crepitus is felt, there is *fracture of the acetabulum in addition to dislocation*.

Injuries of the thigh.—The femur is so deeply placed beneath thick masses of muscle that the outline of its shaft is not plainly felt. First run the hand down the limb and notice any obvious deformity, then measure the length of the thigh and test the bone for mobility in its length and for crepitus. If the bone is bent but the great trochanter moves round with the lower end, and there is no crepitus, it is a *greenstick fracture*. If the two ends of the bone do not move together and there is crepitus, there is *fracture of the femur.* It is important to notice the direction and degree of displacement of the fragments. Shortening of the limb is the measure of the amount of vertical displacement. The lower fragment is usually rotated out and drawn up behind the upper; in fractures high up in the shaft the upper fragment is usually tilted forwards and outwards, and projects in the front of the thigh. There may be no displacement in the case of transverse fractures.

Injuries about the knee.—The special injuries that may be met with in this region may be grouped as follows:

Fractures of the femur, of the tibia, or of the patella, and separation of the epiphysis of femur or tibia.
Dislocation of the tibia, fibula, or patella, or of a semilunar cartilage.
Sprain, rupture of lateral and crucial ligaments, of quadriceps tendon, or of ligamentum patellæ.

First determine the relations of tibia and femur, and notice if the tibia projects in front of or behind the femur, or to either side. Then feel for the head of the fibula at the back of the outer condyle of the tibia, and determine whether it is in its normal position or displaced forwards or backwards. Then feel the patella, and notice whether it is displaced from its normal situation on the front of the femur, and if its anterior surface is directed forwards. With the thumb and fingers the outline of the bones can be easily traced and compared with that of the sound limb.

Being satisfied that there is no dislocation, the surgeon should next examine each bone separately for fracture, noting its outline, any mobility of a fragment, and crepitus. Each condyle of the femur and each tuberosity of the tibia should be grasped separately, and an attempt made to move it on the rest of the bone. The patella should be carefully examined, its outline defined and compared with that on the other side; an attempt should be made to obtain movement in it both transversely and longitudinally; while, failing that, firm pressure should be made all around its edge and across its surface, any crepitus or special tenderness being carefully noticed. A transverse fracture may occur without any separation of the fragments.

Having thus examined the bones for dislocation and fracture, feel the various tendons about the joint, particularly the quadriceps and its continuation the patellar ligament, the ilio-tibial band and the biceps, and determine whether they are entire and in their usual situation; their integrity may be tested by getting the patient to lift the extended limb from the bed and to bend the knee. Then notice the amount of lateral and antero-posterior movement that can be obtained, and the presence or absence of fluid in the knee-joint, and whether there is any "locking" of the joint or sudden setting free of a locked joint. Until the surgeon has satisfied himself that the patella and its muscle and ligament are entire he should not bend the knee-joint, as fracture of the bone and rupture of the ligament may be exaggerated in their effects by such a movement. He should examine closely the interval between the tibia and the femur, to notice any difference between the two limbs, and, of course, he will observe the outline of any swelling of the soft parts.

By this examination (1) it may be demonstrated that the *tibia is dislocated*, either *behind* or *in front* of the femoral condyles, or *laterally*—in the last case the dislocation is incomplete—or that the *head of the fibula is dislocated forwards* or *backwards*, or that the *patella is dislocated outwards*, or on to its *outer edge*. Sometimes the tibia is found to be wider than the femur, and projecting on one side without a corresponding depression on the other side: this shows that there is a *vertical fracture of the tibia* with lateral displacement; the fragment may possibly be movable with crepitus.

(2) If the condyles of the tibia preserve their normal relations with the condyles of the femur, and yet there is considerable deformity near the knee, it must be due to fracture with displacement. The lower end of the *femur* may be *broken* across and the lower fragment displaced into the ham, so that the lower end of the shaft projects in front; with a transverse fracture may be combined a vertical fissure separating the two condyles—T-*shaped fracture*—or one *condyle* of the *femur* may be detached and movable. In children under 16 years of age the *lower epiphysis of the femur* may be *separated* and *displaced in front* of the diaphysis; occasionally it is displaced *laterally*.

(3) Examination of the *patella* may show a *transverse fracture* with varying amount of separation of the fragments, or a *vertical* or *oblique* or *comminuted* fracture of the bone.

(4) Inability to raise the limb from the couch and a gap in the tendon above the patella or in the ligament below may show a *rupture* of the *quadriceps tendon* or of the *patellar ligament*.

(5) If with the knee fully extended the tibia can be displaced forwards on the femur, there is *rupture* of the *anterior crucial ligament*. On the other hand,

if with the knee flexed the tibia can be displaced backwards on the femur, there is *rupture* of the *posterior crucial ligament*. If both abnormal movements can be obtained, *both* crucial ligaments are ruptured. Increased lateral movement of the joint may be due to *rupture* of a *lateral ligament*, which is usually accompanied by tenderness over the injured ligament.

(6) If after an injury there is obstruction to full extension of the knee, *fracture* of the *spine of the tibia* may be suspected, and can be confirmed by an X-ray examination.

Synovial effusion is liable to follow fractures *near* the joint as well as those into it.

(7) When the patient states that during some twisting movement of the knee he experienced a sudden severe pain in the joint with a sense of something having slipped out of place, and of locking of the joint, and if on examining the part there are pain and tenderness just between the inner—or more rarely the outer—condyles of the femur and tibia, and full passive movement is painful, a *tear or a dislocation of the semilunar cartilage* is to be diagnosed. If the accident has happened before, and if the pain has on each occasion been of the same character and at the same spot, and if the patient has felt something, as it were, slip into place again, with relief of the extreme pain, the diagnosis is still more certain. The pain and disability from this accident are often so great as to cause the patient to fall down.

If a swelling is felt on the side of the joint just over the line between the femur and tibia, corresponding to the cartilage in outline and feel, especially if there is a clear history of this swelling having appeared at the time of the accident, and if on manipulation it can be pressed into place, the displacement is *extra-articular*.

Injury to a semilunar cartilage is liable to be mistaken for the impaction of a loose body in the joint, and vice versa. But attention to the following points will enable a diagnosis to be made: A semilunar cartilage is always *first* displaced by a sudden severe wrench of the joint, although subsequently it may slip out of place during slight twists of the joint. The impaction of a loose body between the articular surfaces is not dependent upon a wrench or sudden twist of the joint, but occurs during the customary movements. When dislocated, the semilunar cartilage may be felt projecting; the loose body, on the other hand, cannot be felt when impacted, but may be felt between the attacks of pain floating freely in the synovial cavity. In impaction of a loose body the joint is locked; in dislocation of a semilunar cartilage the joint is capable of passive motion. The pain of a slipped cartilage is always referred to the side of the joint, and almost invariably to the inner side; the pain from a loose body may be felt in various situations in the joint.

(8) If there is no displacement or fracture of any of the articular structures, and the joint is found distended with fluid very quickly after a sprain or contusion, it may be *hæmorrhage* into the joint, especially if the patient suffers from *hæmophilia*. Hæmorrhage into the joint, except in hæmophilia, is nearly always due to a fracture, and more or less hæmorrhage will be found to occur in every case of fracture into the joint.

(9) If after a fall or blow upon the knee the patient complains of pain in the joint, referred either to the patellar ligament, or to the inner side of the joint, or to the popliteal space, increased by putting weight upon the limb, or by full flexion or extension of the joint, and the surgeon finds no evidence of

injury to the bones or to the principal ligaments, but a moderate synovial effusion, it is a case of *sprain with traumatic synovitis.*

(10) If some weeks or even months after a sprain of the knee the patient complains of weakness of the knee and a sense of insecurity, and there is some excess of fluid in the joint, and perhaps soft creaking on movement, it is a case of *chronic post-traumatic synovitis.* In such a case there will almost certainly be found wasting of the quadriceps muscle on the injured side, especially of its inner head, and it is to the loss of support to the joint which results from this wasting that the continuance of the synovitis is chiefly due.

Injuries of the leg.—The tibia for its whole length, and the fibula for some distance, are subcutaneous, and any deformity of the shafts is readily recognized. Deformity is not pronounced unless both bones are fractured. The surgeon should run his fingers carefully down the inner surface of the tibia, comparing it with its fellow, noticing any unevenness in it, the seat of chief pain, and particularly if there is any marked tenderness; then, grasping the leg above and below the most tender or painful part, he should attempt to obtain mobility and crepitus. A similar examination of the fibula should be made, and in addition it should be pressed in towards the tibia just below its head and also above its malleolus, to observe whether this gives crepitus, or causes acute pain at a distance from the point compressed, and whether there is the usual spring in the bone.

This examination (1) may show considerable deformity or free mobility in the length of the bones and crepitus: these signs would indicate *fracture of the tibia and fibula.* The bones may be broken opposite each other by direct violence, the injury being a *transverse*, perhaps *comminuted, fracture.* If broken by indirect violence the fibula generally snaps across higher up than the tibia, and the fracture in the tibia is very often *oblique* or *spiral*, and the fissure may extend down into the ankle-joint. In these cases the most frequent deformity is projection forwards of the lower end of the upper fragment, and rotation outwards, with backward displacement of the foot and lower fragment.

(2) Mobility and crepitus in the tibia, with little or no deformity, indicate a *fracture of the tibia* only.

(3) A fixed pain at one spot in the fibula, with localized tenderness at this spot, a loss of the usual spring of the bone, with pain excited at the tender spot when the two bones are pressed together at some distance from it, would show a *fracture of the shaft of the fibula* only. Pain, tenderness, and deformity are sometimes found at the neck or upper end of the fibula, and signify a *fracture of the neck of the fibula.*

(4) A very tender line or ridge in the shaft of the tibia without mobility or crepitus may indicate an *incomplete fissured fracture*; the X-rays would establish the diagnosis.

(5) If during some sudden exertion the patient experiences a severe pain in the calf, or behind the ankle, feeling as if he had been struck on the part, and loses power in his leg, and on examination the bones and joints are found uninjured, but above the heel there are ecchymosis and swelling, and a depression is felt where the prominent tendo Achillis should be, the surgeon will have no difficulty in diagnosing a *rupture of the tendo Achillis* (*tendo calcaneus*). When with these symptoms this tendon is found entire, but all voluntary attempts to extend the ankle give great

pain, while passive movement of the joint is free, a *rupture of the plantaris tendon* is to be recognized. Rupture of the tendo Achillis may be attended with a loud snap.

(6) If in a patient under 20 years of age, with or without the history of a strain or overuse, there is a tender swelling over the tubercle of the tibia and the patient walks with a limp, and the X-rays show projection forwards and some irregularity of the lingual process of the epiphysis, the condition is *Schlatter's* or *Osgood's disease.* (Plate xii., Fig. 3, facing p. 353.)

Injuries about the ankle and of the foot.—Under this head is included a large group of injuries: fractures of the lower ends of the bones of the leg and of the bones of the foot; dislocations of the fibula, the ankle, of the foot from the astragalus (talus), and of individual tarsal and metatarsal bones; displacement of tendons, and sprains. Exact diagnosis is often very difficult, owing to the swelling that quickly obscures the bones, and sometimes also to the correction of characteristic deformity before the surgeon sees the patient. X-rays, therefore, are of special importance in the diagnosis of these injuries.

The **examination** should be made with great care, and should aim at determining (1) the relative position of the various bones, (2) the integrity or the reverse of each bone, (3) the position of certain tendons which are very liable to displacement.

1. *The relative position of the bones.*—(*a*) Notice whether the foot is in line with the leg, or displaced to either side, forwards, or backwards.

(*b*) Notice whether either malleolus is unduly prominent or sunk in, and whether there is any depression in the fibula above the malleolus.

(*c*) Measure the width of the ankle, between the two malleoli; any increase in the width is due to fracture, or rupture of the interosseous ligament.

(*d*) Measure the distance from either malleolus to the point of the heel, from the outer malleolus to the base of the fifth metatarsal bone, from the inner malleolus to the tubercle of the scaphoid, and from each malleolus to the sole of the foot.

(*e*) Feel the os calcis, the head of the astragalus (talus) in front of the tibia with the scaphoid bone in front of it and concealing its rounded articular end, the cuboid on the outer side, the cuneiform bones in front of the scaphoid, and the bases of the metatarsal bones.

2. Having determined the relative positions of the bones, *test each bone for mobility and crepitus.*

(*a*) Grasp the ankle and try to move it anteroposteriorly and laterally upon the leg, then seize each malleolus and try to move it.

(*b*) Feel the outline of the os calcis, and notice whether any part of it can be moved, and if the attempt to do so causes crepitus.

(*c*) Move the ankle and transverse tarsal joints, and notice any crepitus, also notice the range of movement in these joints.

(*d*) Test the rigidity of the metatarsus, and of the phalanges, and notice crepitus.

3. Feel the tension and notice the prominence of the Achilles tendon, and see whether a tendon has slipped forwards over either malleolus.

As previously mentioned, the presence of discoloured blebs in a swollen part is usually evidence of fracture of a subjacent bone.

By this examination the following injuries can be recognized:—

1. If the whole foot is displaced outwards so that the inner malleolus is prominent and there is a

depression on the outer side of the leg above the malleolus, and the foot is everted, it is *Pott's fracture*, i.e. a partial dislocation of the ankle outwards with a fracture of the fibula 3 in. or less from the external malleolus. Very often the foot is also displaced backwards, causing the heel to be unduly prominent.

2. If the whole foot is displaced outwards, the width of the malleoli greatly increased, and the distance from the malleoli to the sole shortened, it is *Dupuytren's fracture*, i.e. a Pott's fracture plus rupture of the inferior interosseous ligament.

3. If the foot is displaced outwards with the outer malleolus sunk in a deep hollow, and the head of the astragalus projects in front of the inner malleolus, it is a *subastragaloid dislocation outwards.*

4. If the foot is displaced inwards, the inner malleolus being sunk in a hollow, and the rounded head of the astragalus projects in front of the outer malleolus, it is a *subastragaloid dislocation inwards.* The whole foot may be displaced inwards in some fractures of the lower end of the tibia and fibula.

5. If the prominence of the heel is increased and the distance between the malleoli and scaphoid and fifth metatarsal bone lessened, the foot is displaced backwards: this may be due to Pott's fracture, to a dislocation of the ankle, or to a subastragaloid dislocation of the foot. To determine the latter point, feel for the astragalus; if this is under the arch of the tibia, so that its convex head is prominent on the top of the scaphoid, and its large saddle surface cannot be felt, the *dislocation is subastragaloid*; while if there is no bony prominence in front of the tibia, it is a *dislocation backwards at the ankle-joint*; the saddle-shaped surface of the astragalus will only be indistinctly felt between the back of the tibia and the tendo Achillis (tendo calcaneus).

6. If the prominence of the heel is lessened and the distance between the malleoli and scaphoid and fifth metatarsal bones is increased, there is a dislocation forwards. If the saddle-shaped surface of the astragalus is felt in front of the tibia, it is a *dislocation forwards of the ankle ;* while if this cannot be felt, but the rounded head of the astragalus projects a short distance in front of the tibia, it is a *subastragaloid dislocation of the foot forwards.*

7. The foot being in line with the leg, the heel may be displaced outwards from *dislocation of the os calcis*—a very rare accident.

8. If there is no gross deformity of the foot but the heel is painful and swollen, and the patient is unable to bear weight on the foot, and no crepitus or pain is elicited on passive movement of the ankle, there is probably a *fracture of the os calis.*

9. If the malleoli are approximated to the sole, but not widened, and the foot is not displaced forwards or backwards, there must be a *dislocation of the astragalus* (*talus*) ; the bone may be found in front of or behind the tibia—in front its outline is easily recognized. But if the malleoli are greatly widened and the heel raised, and the foot is, as it were, buried between the malleoli, there is *dislocation of the foot upwards between the bones of the leg.*

10. If the front half of the foot is displaced and the front of the os calcis projects on the outer side and the scaphoid projects much beyond the astragalus and malleolus on the inner side, it is because there is *dislocation inwards at the mid-tarsal joint.* If the lateral projection is farther forwards, it is due to *dislocation of the metatarsus ;* the displacement of the metatarsus may be to either side, or on to the dorsum of the tarsus or into the sole.

11. A single tarsal bone may be felt dislocated on to the dorsum of the foot; the position and outline of the projection determine the diagnosis.

12. In the toes a *dislocated phalanx* may be recognized.

13. When the foot is grasped at the ankle and moved laterally or antero-posteriorly, there may be yielding of the tibia and fibula and crepitus, showing *fracture of the bones close above the ankle*; in some cases the foot slides up and back owing to there being an oblique *fracture of the back of the tibia.* In young people under 18, if the crepitus is soft it would indicate *separation of the lower epiphyses of the tibia and fibula.*

14. Either malleolus may be found movable owing to *fracture*, or there may be a separation of the *epiphysis of the fibula.*

15. The tuber calcis may be movable either from *fracture* or *diastasis.*

16. If there is no sign of displacement or mobility of any of the bones, and yet on moving the ankle there is deep crepitus, and any attempt to stand causes severe pain, the symptoms are probably due to *fracture of the astragalus* (talus).

17. Mobility in the *metatarsus* or in a *phalanx* with crepitus will indicate *fracture* of these bones.

18. If there is no displacement of any bone, nor crepitus, but the patient complains of pain in front of either of the malleoli, and an elongated ridge is felt there, it is a *displaced tendon*; the tibialis posticus may slip over the internal malleolus, and the peroneus longus over the outer malleolus.

CHAPTER XVII

DIAGNOSIS OF SWELLINGS AND TUMOURS

THE facts upon which the diagnosis of the nature of a swelling or tumour rests vary in different cases, but they may be all grouped under six heads. These groups of symptoms will be considered seriatim in this chapter. If students are methodical in their examination of tumours and avoid the evil practice of jumping to conclusions from some one fact or symptom, and especially if they keep clearly in their minds the two or three leading considerations upon which diagnosis should rest, they will find that they can solve by clinical examination alone most of the problems that arise in connexion with the diagnosis of tumours. The method recommended is as follows: (1) Determine in what structure or part the tumour is situated; (2) notice the physical characters of the tumour; (3) investigate the life-history of the tumour; (4) study the effects of the tumour upon surrounding tissues; (5) after this consider what light the condition of the patient throws upon the case; (6) in some cases it is necessary to submit portions of the tumour to chemical, microscopical, or bacteriological examination.

I. THE STRUCTURE OR PART IN WHICH A TUMOUR HAS ARISEN

1. The structure with which a tumour is connected is to be determined by noticing first of all its

exact position and shape. These may correspond to certain structures or organs, as for example effusions into joints, bursal swellings, psoas abscess, varix, a distended urinary bladder, extravasated urine, bronchocele, enlarged glands, epididymitis, misplaced testicle, movable kidney, etc.

2. Next try to demonstrate its **adhesion to one or more tissues of a part,** as shown by its mobility with the tissue or organ affected, and its immobility apart from it. This is a sign of great importance and of wide application. Nearly all the normal tissues of the body allow of a certain amount of movement one upon the other: muscles move over each other and over bones; the skin is movable over muscles, deep fascia, and bone. The exceptions are in the case of the structures forming the scalp, the mucous covering of the hard palate, the gums, the teeth, the nails, the skin of the palm and sole, the sheaths of muscles, and the periosteum; these are not movable over the subjacent parts.

Immobility of a swelling upon a part may be due to organic connexion with it, as in the case of an exostosis, or of the inflammatory enlargement of any organ. It may be also caused by its being so bound down or shut in that it has no independent movement; and special care must be taken to distinguish between these two conditions. The simplest illustrations of this difference are seen in such cases as hydrocele and tumour of the testicle, impacted fæces and growths of the colon, pregnancy and uterine myoma; other examples are parosteal and osteal tumours, and all tumours under muscles and deep fasciæ. During the examination, wherever possible, hollow viscera should be emptied, and all muscles and fasciæ should be relaxed.

The adhesion may be *primary*, the tumour actually springing from the tissue, as in the case of aneurysm, sebaceous cyst, gumma, exostosis; or it may be *secondary*, occasioned only by the growth of the tumour, as in abscesses gradually reaching the surface, a mammary carcinoma involving the skin, and malignant tumours of all kinds, which, by their infiltrating mode of growth, become adherent to surrounding tissues as they enlarge. The adhesion or connexion of a swelling with more than one tissue is an especial feature of inflammatory and malignant tumours.

Adhesion to the *skin* is sometimes obvious at a glance, as in the case of cutaneous warts. In the case of deeper swellings it is to be tested by attempting to glide the skin over the swelling, while it is held fixed, and by pinching the skin up in a fold over every part of the surface. Or the tumour may be moved, and any dimpling or dragging upon the skin so caused be taken note of. It must be borne in mind that by mere tension a tumour of large size considerably lessens the natural mobility of the skin over it.

Connexion with the *subcutaneous tissue* is shown by the mobility of the tumour under the skin and over the muscles or other deeper tissues. The best example of such a tumour is the common fatty tumour. As the skin is normally connected with the subcutaneous fat by fine fibrous processes continuous with the dissepiments of the fat, such tumours show a slight dimpling of the skin over them when it is pinched up.

Adhesion to the *deep fascia* of a part is shown by limited mobility of the tumour which is lost when the fascia is rendered tense. There is great difficulty in demonstrating this adhesion—first, because in some places the fascia is so united to the muscles that the two cannot be clinically separated; secondly, because tension of the deep fascia fixes a swelling lying beneath it, as well as one attached to it. It is often impossible to move the fascia without at the same time putting other structures on the stretch.

Adhesion to *muscle* is detected by studying the effect of contraction and relaxation of the muscle upon the tumour. When relaxed, the tumour is as mobile as the muscle, and chiefly across its length; when the muscle is strongly contracted the tumour is immovably fixed, and often slightly altered in position. A movable tumour beneath a muscle is fixed when that muscle is strongly contracted; when the muscle is relaxed it may be as mobile in the length of the muscle as across it.

Adhesion to a *vessel* is diagnosed by noticing that the tumour, while movable over skin, muscle, and bone, and transversely to the line of the vessel, is not movable in the line of the vessel. In many cases tumours adherent to vessels are also adherent to nerves, muscles, and other structures.

The mobility of *nerve-swellings*, or neuromata, is characteristic; for while it is free in the direction transverse to the long axis of the swelling or of the nerve, there is no mobility in the length of the nerve. This is similar to what is observed in connexion with vessels, but is more striking, as the mobility of neuromata in the transverse direction is greater than that of aneurysms, thrombi, or phleboliths. Neuromata are not liable to become fixed to neighbouring structures.

Adhesion to *bone* is determined by the immobility of the tumour apart from the bone. Apparent mobility of a tumour that is really fixed may be caused by its elasticity, or by the mobility of structures over it, as, for example, in the case of an exostosis of the femur with a large movable bursa developed upon it.

The adhesion of a tumour to a *gland*, e.g. the thyroid or the breast, is determined by noticing whether the tumour always moves with the gland. (*See* Chap. XXXIV.)

The *range of mobility* of a swelling or lump may determine its position; as, for instance, a loose body in a joint, in a bursa, or in the tunica vaginalis, tumours of the omentum or mesentery, and some renal, ovarian, and uterine tumours.

Mobility during certain acts may determine the connexion of a tumour with a tissue or organ which only moves then; good illustrations of this are the rise and fall of a goitre during deglutition, and the descent of a liver tumour during inspiration.

In addition to these common signs by which the part affected can be recognized, there are in some cases certain special signs which are of great value in diagnosis. Thus the effect of *emptying a viscus* will sometimes at once determine the seat or nature of a tumour, as when an abdominal tumour disappears on a catheter being passed, or when free purgation has eliminated large masses of fæces. *Periodic enlargement of a swelling* during functional activity of an organ may reveal the nature of a tumour, as in the case of a hernia of an ovary, or the distension of a salivary gland behind a calculus in its duct. The increased tension of a popliteal bursa in extension of the knee-joint shows that the tumour communicates with the joint.

The *hardening of a swelling under the hand* shows that it is muscular, and this sign may help in the recognition of a gastric or uterine tumour, or of an intussusception.

II. Physical Characters of Tumours

First determine whether the tumour is solid, liquid, or gaseous, or a combination of two or all of these, for a tumour may be either uniform or varied in its nature.

Gas may be present in a tumour, (*a*) being contained in one of the gas-containing viscera, as in pneumatocele or hernia; or (*b*) having escaped from one of these viscera, as in cutaneous emphysema; or (*c*) having arisen from decomposition, as in some cases of abscess and of gangrene. In gangrene the *bubbles of gas may be seen* in the superficial bullæ and veins. When the gas is contained in the connective-tissue spaces, it gives a *fine dry crackling* sensation to the fingers, and the swelling yields when compressed. When the gas is mixed with liquid, its manipulation gives a *gurgling sound*, as is often perceived in the reduction of a hernia. But the most important physical sign of the presence of gas is a *tympanitic percussion note;* this is only obtained when the gas is present in considerable proportion, as in pneumatocele, subcutaneous emphysema, tympanites, and enterocele.

The **presence of fluid** in a tumour is determined by one of three signs: 1, fluctuation; 2, fluctuation wave; 3, pitting on pressure.

1. **Fluctuation** is the name given to the sensation caused by the displacement of fluid within a swelling. To observe fluctuation, place the balls of the fingers of one hand on one side of the swelling, and then with the fingers of the other hand gently press into the tumour; if the tumour is felt to rise under the fingers of the first hand, it is due to the displacement of fluid, and this sensation is *fluctuation.* The precautions to observe in reference to this sign are

these: (*a*) Always *use two hands;* the manipulation should never be conducted with the fingers of one hand only. (*b*) Be careful to *fix the tumour* with one hand, so that the pressure of the other does not move it *en masse,* but, if liquid, merely displaces a part of its contents; the unpractised observer may easily mistake mobility of a tumour for fluctuation. (*c*) *One hand only* should be used *to compress the tumour,* the other being immovable on the swelling; if both the hands are moved, an error is very easily made. There is, of course, no objection to alternating the hands, but there is no advantage in so doing. (*d*) Fluctuation should be obtained in at least *two different directions* across a swelling. In collections of fluid the displacement occurs equally in all directions; in some solid tumours a sense of fluctuation may be obtained in one direction only, but not in more than one, as across muscle, for example; in narrow elongated collections of fluid, as in teno-synovitis, it may be difficult or even impossible to obtain this sign across the swelling, owing to its narrowness. (*e*) Care must be taken not to mistake mere *elasticity or compressibility* for a sense of fluctuation; this is best avoided by noticing that the sign is detected by the stationary hand, not by the compressing hand. It is not the fact that the tumour yields to pressure, but that its contents are displaced and that the size and tension of the rest of the tumour are increased, that constitutes fluctuation. It requires practice and skill to detect fluid in small quantity or at a considerable depth; where doubt is entertained, it can be removed by puncturing the swelling with a sterilized exploring syringe of sufficient calibre.

It may be well to enumerate the errors that may be made in connexion with this very important sign.

The surgeon may fail to obtain the sense of fluctuation in fluid swellings because of—

(*a*) The great depth of the fluid.
(*b*) The small size of the swelling rendering the manipulation very difficult.
(*c*) The extreme tension of the fluid.
(*d*) The extreme lack of tension of the fluid.

He may wrongly suppose that he obtains the sense of fluctuation in non-fluid swellings if—

(*a*) The tumour is very elastic.
(*b*) The tumour is very soft.
(*c*) The tumour is very movable.

For the diagnosis of fluctuating swellings, *see* Chap. XIX.

If the fluid of a tumour contains numerous small solid bodies, the displacement of these may give rise to a very characteristic *thrill.* This sign enables the surgeon to detect the presence of "melon-seed bodies" in a joint, a bursa, or a ganglion. In some cases of hydatid tumour, if the left hand is placed on the swelling and percussed with the right, a fine thrill or fremitus is perceived, called the *hydatid fremitus*; it is attributed to vibrations set up by the impact of the daughter cysts in the mother sac. On listening over a hydatid tumour when thus percussed a musical sound may sometimes be heard.

2. A **fluctuation wave** is obtained in cases of *large collections of fluid*, with more or less tense walls, as in unilocular ovarian cyst and in ascites. It is felt by placing the palm of one hand smoothly over one side of the swelling and then sharply tapping the opposite side of it with a finger or fingers of the other hand; a distinct wave is felt, as it were, to strike the palm. This sign should be obtained across more

than one diameter of the tumour, and care should be taken not to mistake a mere impulse or wave conveyed along the covering of the tumour for a wave transmitted through it: the former is never such a sharp, abrupt impulse as the true fluctuation wave; this source of error may be eliminated by gently pressing upon the coverings somewhere between the two hands. In the case of the belly this is usually done by getting an assistant to place the edge of his hand on the abdominal wall between the hands of the surgeon, and by that means to interrupt any wave passing that way.

3. **Pitting on pressure.**—If on pressing a finger into a swelling it yields, and a pit is left which is gradually filled up when the pressure is removed, the phenomenon is known as "pitting on pressure." This is due to liquid or gas infiltrating the cellular tissue; the condition of fluid infiltration of cellular tissue is known as *œdema.* It may also be recognized, but not so surely, by a lessening or total obliteration of the natural wrinkles of a part.

Gaseous infiltration is easily distinguished from œdema (1) by a tympanitic percussion note, (2) by a fine crackling sensation when compressed, and (3) by the rapidity with which the "pit" is filled up. Œdematous cellular tissue is always dull on percussion; the displacement of the fluid by pressure is unaccompanied by thrill or crackle. By noticing the ease and rapidity with which a "pit" can be made and is then obliterated, an estimate of the tension of the extravasated fluid can be arrived at.

Œdema is caused by (*a*) acute inflammation, (*b*) venous obstruction, (*c*) the effect of gravity, (*d*) urinary infiltration. If *inflammatory*, it is localized and accompanied by the usual signs of inflammation, i.e. pain, tenderness, heat, and fever, and usually by redness; much surrounding œdema is sometimes a useful indication that the inflammation has run on to suppuration. When due to *venous obstruction* it corresponds in area with that of the tissues draining into the affected veins. When the effect of gravity upon a disordered circulatory control, as when it occurs in an injured leg on the patient first getting up, it will disappear spontaneously if the limb be replaced in a horizontal position. The peculiar limits of *urinary infiltration* sufficiently characterize that form of œdema. The limits and extent of œdema should always be carefully ascertained; where local it owns a local cause, and vice versa. (*See* p. 239.)

Swellings which are dull on percussion, and neither fluctuate nor pit on pressure, are solid.—Solid tumours may be so soft and yield so much to pressure that care is required to distinguish them from fluid tumours: lipoma and myxoma are examples of this. Or they may be of any consistence firmer than this, up to the incompressible hardness of bone. Of the firm tumours may be mentioned fibroma, adenoma, and many sarcomata; of the very firm but still slightly elastic and compressible tumours are enchondroma and scirrhus; cartilaginous tumours only yield very slightly to pressure, and the recoil is very rapid; of the absolutely hard unyielding swellings we have osteoma, calcified tumours such as phleboliths, and swellings due to calculi. In examining the consistence of a solid tumour, a peculiar crackling may be met with; where this is very dry and high-pitched, like the sensation produced by compressing a cracked egg, it is known as *egg-shell crackling*, and is caused by the yielding of a very thin plate or shell of bone over a softer tumour. A similar sensation but less dry and of a lower pitch, is produced by the like yielding of a thin plate of cartilage. This sign is a useful indication of the expansion of bone by a tumour growing in its interior; when it affects the articular end of a bone and expands the articular cartilage, the softer sensation may be felt. A very similar sensation may be felt in cases of subperiosteal cephalhæmatoma and of dental cyst, where the pericranium or the periosteum bends like stiff parchment under the finger. The grating of calculi over each other is sometimes felt in examining cases of biliary and prostatic calculi.

Swellings may **vary in consistence** in different parts or at different times, and a knowledge of this fact may aid in the diagnosis. The association of firmer and softer solid material in one swelling indicates sometimes that a soft tumour growing within a hard substance has at one or more places burst through the enveloping tissue; this may be observed in the growth of central sarcoma of bone. At other times it shows that the soft tissue has undergone some indurating change, as when a sarcoma chondrifies or ossifies; while in other swellings it indicates that the tumour is composed of quite different constituents, as intestine and omentum in a single hernial sac. Still more common is the association of solid and fluid parts in one swelling, and this may arise in at least three ways. Where, with signs of inflammation, part of a solid swelling becomes fluctuating, suppuration may be recognized. Where, on the other hand, such a change takes place without any indication of inflammation, a degenerative softening of the tumour, or a growth of a cyst or cysts, is the cause; and the distinction between these may be difficult, but the more tense and the more globular the collection of fluid the more likely is it to be a cyst, and not a collection of soft detritus. The association of cystic and solid matter in a tumour is characteristic of cystic hygroma, cystic sarcocele, and many other tumours. Variation in their consistence, while a frequent feature of malignant tumours, especially sarcomata, is rarely seen in benign growths. Secondary epitheliomatous growths in glands often soften into fluctuating swellings.

The **form of a tumour** must be carefully observed, as it not infrequently aids very materially in the diagnosis.

A tumour or swelling may have the form of one of the **normal structures of the body**, and so prove its relation with such structure, e.g. bronchocele, psoas abscess, displaced kidney.

The **globular shape** of a neoplasm indicates the uniform yielding of the implicated tissues to the pressure of the growth, or the general implication of all tissues equally in a rapidly growing tumour. Thus we find that cysts of all kinds tend to assume a globular outline, so also do sacculated aneurysms and diseased joints when the fibrous structures are softened and are no longer able to maintain the normal outline of the part, while soft sarcoma and carcinoma frequently assume a globular shape. The globular form of dermoid or sebaceous cysts distinguishes these swellings from ovoid fatty tumours and hemispherical abscesses.

A tumour may be **lobulated**, and this may be characteristic. Thus the fine lobulations caused by the distension of the acini of the mamma in milk congestion are quite characteristic of glandular distension. The flattened ovoid lobulation of a fatty tumour is also distinctive; and the presence of omentum in a hernial sac is usually easily determined by its granular and loosely lobulated feel. Coarser lobulation of tumours may be due to yielding of the surrounding tissue in certain directions only, as in some ganglia; to cystic formation, as in cystic disease of the mamma and testicle; to an inherent mode of growth of the tumour, as in enchondroma; or to multiplicity of the tumours, as in uterine fibroids. Lobulation may also be explained by the anatomical relation of the swelling, as in psoas abscess.

The **retraction** of a tumour is an important character, indicating a contraction of the tissue; it is a special feature of scirrhous carcinoma.

Other characteristic forms are the *warty* or *villous*, the *pedunculated* or *polypoid*.

Translucency of a swelling shows that it consists of a collection of transparent fluid, serous or synovial; and it is, therefore, a diagnostic sign of great importance. To test for translucency, the tumour should be grasped so that it is made tense and the skin stretched tightly over it; a good light is then to be held close to it on one side, while the observer's eye is on the opposite side, the rays of light which pass over the surface of the swelling being shut off by the hand or some suitable screen; if it is translucent, the light is seen through the swelling more or less intensely. Some prefer to look through a stethoscope, a roll of paper, or some similar tube. Translucency may be missed by carelessness in carrying out this manœuvre; thus, a scrotal swelling may be so held that the patient's penis, or the sound testicle, or the surgeon's hand comes between it and the light, the rays of light being thus interrupted; or one part only of a swelling which is partly solid and partly fluid, such as a hydrosarcocele, may be examined. On the other hand, it may be wrongly detected if the observer is not careful to shut off from his eye all the rays of light except those passing into the swelling; thus, if a stethoscope or other tube is used and the end is not placed quite firmly and uniformly on the swelling, light passing into the tube under its tilted end may be mistaken for that passing through the swelling. Tumours usually translucent may be opaque through great thickening of the covering, as in some cases of old hydrocele; or through a change in the fluid, as when hæmorrhage occurs into a hydrocele, or a serous cyst becomes inflamed and suppurates. When testing for translucency it is always well to examine the whole swelling, both because a translucent part may otherwise be overlooked, and also to localize exactly any opaque portions. In this way the position and approximate size of the testicle in a hydrocele, or the presence and position of the spinal cord or nerves in a spina bifida, may be determined. Although translucency is positive evidence of the presence of a clear fluid in the swelling, serous or synovial, the surgeon must remember that opacity is not by itself evidence of the absence of such fluid.

The coverings of a tumour may be so thinned as to become transparent and allow the colour and appearance of the swelling to be seen through them, as e.g. a pointing abscess, a spina bifida with a very thin sac, a nævus, a sebaceous cyst, dilated veins, a melanoma, or a chloroma.

Opacity of a tumour to X-rays.—A good deal may be learnt about the nature and the position of a tumour by a careful examination with X-rays. A gas-containing tumour is quite translucent, a cyst is nearly so, and its shadow is uniform unless its wall is calcified or ossified, or has opaque dissepiments which give a darker shadow. Abscesses are more opaque than cysts, but like them give a uniform shadow. Solid tumours usually give a faintly striated shadow. Bony tumours give a deeper shadow, and the arrangement of the bone lamellæ can be traced in a good skiagram. The relation of a tumour-shadow to the shadows of adjacent bones and viscera often gives great help in diagnosis, as for instance in cases of aneurysm, mediastinal tumour, psoas and other deep abscesses. In some cases the contrast between the shadows can be artificially increased with great advantage. Thus, the stomach or colon can be inflated with transparent gas, or rendered very opaque by a bismuth meal; the urinary bladder may be made transparent by inflation, or opaque by being filled with a solution of protargol or sodium bromide; the ureter may be made to stand out on a photographic plate by the passage into it of an opaque bougie; and the pelvis and calyces of a kidney can be gently filled, like the bladder, with an opaque solution. Occasionally the relations of a tumour itself translucent may be revealed by the deformity it produces of the shadow of an opaque part, e.g. when a distended gall-bladder indents the outline of a barium-filled duodenum. Of even greater value is a good skiagram when it shows a tumour, or its exact extent and position, which cannot be recognized by any other means, as in growths in the spinal column, in the mediastinum, in the antrum of Highmore, or in the interior of bones before any alteration in the outline of the bone is produced.

Reducibility of tumours.—Some tumours are reducible, either wholly or in part, really or apparently, and the observation of this fact may throw great light upon their nature. A tumour is *really* reduced when its contents are emptied out of its capsule into one of the normal cavities of the body or into the vessels of the part. Examples of this are seen in hernia, some forms of hydrocele, varix, aneurysm, and meningocele. A tumour is *apparently* reduced when it disappears from its original position, but is not emptied out, and still remains of its original size. We see examples of this in the reduction of hernia *en bloc*, in some cases of tumour of the spermatic cord, and of cryptorchism; in psoas abscess, where the femoral pouch can be emptied into the abdominal; and in effusion into the bursa beneath the semimembranosus tendon, when this does not communicate with the knee-joint. In the limbs the reducible contents of tumours are always fluid (blood, pus, synovia); in swellings in connexion with the trunk the contents may be solid or fluid, as in hernia and varicocele. Reducible tumours are liable to temporary increase of their usual bulk, and the conditions under which they become overfull or emptied often aid materially in diagnosis. Position, pressure, and effort or strain are the means usually employed to cause these variations in tumours.

Position.—It is only the most easily reducible swellings, and particularly varices, that are affected by position. In the dependent position dilated veins, whether in the limbs or scrotum, fill out, and when the part is raised they at once empty, either wholly or partially. Some herniæ slip up and down with alterations in the position of the patient.

It must be observed that œdema may be greatly modified by, or only appear in, the dependent position. When this is the case the œdema is certainly passive. A vaginal hydrocele, although entirely irreducible, may be fuller in the evening than in the morning, owing to increased exudation during the day. In both œdema and hydrocele, however, the change takes place slowly.

Position has a further influence upon tumours, due to the altered tension of muscles and fasciæ accompanying changes in position of the limbs. A typical illustration of this is seen in the case of effusion into the bursa between the tendon of the semimembranosus and the inner head of the gastrocnemius. When the knee is flexed these muscles are lax, and the swelling partially or wholly disappears, the fluid bulging the sac towards the space of the ham; but when the knee is extended these two muscles are tightly stretched and compressed one over the other, and the fluid is driven from between them and distends the superficial part of the bursal sac, causing a prominent swelling behind the inner side of the knee.

Pressure.—When exerting pressure we are enabled to judge of the amount of resistance to reduction, to note the manner of reduction, whether sudden or gradual, and any special accompaniments of the process. Venous tumours are always very rapidly reduced by pressure; other fluid tumours, such as hydrocele and abscess, are steadily reducible, and whether rapidly or slowly depends upon the size of the aperture for reduction and the amount of resistance in the cavity into which they are reduced. If the contents of the tumour are fluid, containing numerous small solid particles in suspension, a fine thrill is detected by the finger during reduction.

Solid tumours go back with a sudden motion recognized as a "slip"; and the reduction of intestine is often accompanied by a gurgle. By the use of pressure, too, we are able to judge of the completeness or incompleteness of the reduction, as in the case of partially reducible hernia, or reducible hernia conjoined with an irreducible hydrocele. By following up the reduced swelling we may generally ascertain with the finger the aperture through which reduction has taken place. The effect of pressure upon individual blood-vessels above or below a swelling may give valuable information. Thus, pressure on an artery feeding an aneurysm causes a partial shrinking of the swelling, and then pressure upon the sac causes its further reduction. (*See* Chap. XX.) Again, in cases of varix of the lower limb, if when the limb has been raised and the veins have been emptied pressure is made upon the upper end of the internal saphena vein (vena saphena magna), and when the patient stands up the swelling previously noticed does not reappear until the pressure on the vein is removed, it shows both the connexion of the varix with the saphena vein, and the fact of venous regurgitation.

Effort or **strain** causes distension of tumours which consist of the contents of the abdomen or thorax, and of those which are influenced by obstruction to the venous circulation. The production of, and especially the filling out of, or impulse in, a hernia during strain or coughing is one of its most characteristic signs; a similar impulse is observed in congenital hydrocele, in some tumours of the cord, in psoas and iliac abscess, and in pneumatocele. The increased tension of tumours produced by the venous obstruction attendant upon straining efforts is particularly seen in venous nævi, varicocele, and in spinal or cranial meningocele and hernia cerebri, where the venous congestion in the spinal or cranial cavity presses out into the tumour more of the cerebro-spinal fluid. It is important to distinguish a true *impulse*, or filling out of a swelling, from a mere thrust forwards of a tumour, or *displacement*. (*See* Chap. XX.)

Pulsation is of the utmost importance as a symptom; in all cases it indicates a special connexion of the tumour with the arterial system. It is necessary to bear in mind, however, that pulsation is only observed when the passage of blood into a part meets with a certain amount of resistance: thus, when an aneurysm or an artery ruptures subcutaneously and the blood is diffused in the loose tissue of the part there may be no pulsation in the swelling. Pulsation in a swelling may be due (*a*) to the direct communication of an artery with the swelling, as in aneurysm or aneurysmal varix; (*b*) to the presence of numerous pulsating arteries in the tumour, as in aneurysm by anastomosis, in pulsating bronchocele, and in very vascular sarcoma; (*c*) to the presence of an artery in close contact with the swelling, to which it transmits its pulsation, as in some cases of enlargement of popliteal glands, and of tumours of the thyroid gland and some abdominal tumours. (For the diagnosis of pulsating tumours *see* Chap. XX.)

The **colour** and **vascular condition of the skin** covering a swelling are often noteworthy.

The skin may be **reddened**, and, if so, care must be taken to distinguish between certain varieties of this discoloration. If the colour is not altered by pressure, it is due to escape of blood from the vessels, the result being spoken of as *petechiæ* if in small isolated spots, or as a *bruise* or an *ecchymosis* if more diffused; such a condition aids in the diagnosis of purpura, scurvy, hæmatoma, contusion, or the rupture of an artery or vein. If, however, the colour disappears on pressure it shows that it is due to blood circulating in the vessels, and the rapidity with which it returns corresponds with the activity of the circulation in the part. When the red colour is uniform and individual dilated vessels cannot be detected, the condition is due to capillary vasomotor dilatation, and is very often inflammatory in nature; such inflammatory redness of the skin may be of secondary origin, e.g. the intertrigo over a large scrotal or umbilical hernia or a large pendulous fatty tumour. When the bright capillary inflammatory redness is associated with œdema it is a useful sign of suppuration; the redness of inflammation is always accompanied by increased local heat. If the colour is not thus uniform, but the individual vessels can be seen with clear spaces between them, the hyperæmia is limited to vessels larger than capillaries, and is certainly not inflammatory; if of a purple tint, it is probably due to obstruction to the venous circulation. Where, however, this dilatation of vessels larger than capillaries containing blood of a bright-red colour is seen over malignant tumours, it often indicates the involvement of the skin in the morbid growth; in some cases it is the result of treatment by X-rays.

To be carefully distinguished from the above forms of redness is the *nævoid condition*, the appearance of which is quite characteristic: the colour varies from bright to dark red, the affected skin is slightly raised, always sharply defined, and often presents an uneven appearance from the looped and pouched arrangement of the vessels; the condition of skin is usually congenital, or appears soon after birth. Such a state of the skin indicates that any subjacent swelling is either a nævus or some form of congenital tumour.

The skin may be **pigmented.** This is met with in moles, and in the results of degeneration of nævi. Pigmentation also results from prolonged congestion and from X-ray treatment; it is then less defined, and shades away at the edge, unlike a hairy mole. The black colour of a melanotic sarcoma may be seen in the skin or mucous membrane. Hairy or pigmented moles frequently become the seat of epithelioma or melanoma.

III. VITAL CHARACTERS OF TUMOURS

The important features of the life-history of a tumour are the history of its first appearance, its progress, its mode of growth, the pathological changes occurring in it, and evidence of infectivity.

1. The **history of the first appearance** of a swelling will often throw great light upon its nature. The following varieties may be distinguished:

i. **Congenital tumours.**—These include *malformations*, such as meningocele, encephalocele, spina bifida, attached fœtus, included fœtus, congenital dislocation, hydrocele, and hernia; *cystic* tumours, such as dermoid cyst and cystic hygroma; *solid* tumours, such as lipoma, fibrous tumour of gum, scalp, or skin, sacral and coccygeal tumours; *hypertrophies*, seen particularly in the limbs; *vascular growths*, or the different varieties of nævus; and *thickenings* around bones in cases of intra-uterine fracture.

ii. **Swellings arising suddenly.**—Such a swelling can only be caused by (1) the displacement of parts, as in dislocations, hernia, and pneumatocele; (2) the rapid effusion of blood, as in traumatic aneurysm, hæmatocele, hæmatoma; or (3) the escape of the contents of the hollow viscera, as in some cases of traumatic emphysema and in extravasation of urine.

(1) *Displacement of parts* will be recognized by three signs: (*a*) the absence of the part from its normal situation, as e.g. the head of the humerus immediately below the acromion, or the head of the radius below the external condyle of the humerus; (*b*) the continuity of the swelling with the part

supposed to be displaced, as when the swelling produced by a displaced bone moves when the other end of the bone is rotated, or its connexion is traced by the finger passed along it, or is shown by certain special signs, as the reducibility and impulse in a hernia, and the respiratory modifications of a pneumatocele; and (*c*) the character of the swelling resembling that of the displaced organ, as the rounded head of the humerus, smooth tympanitic gurgling intestine, or granular omentum.

(2) *Rapid effusion of blood* will be distinguished (*a*) by the absence of the above signs, and also of those associated with the escape of the contents of the hollow viscera; (*b*) by the evidence of the fluid nature of the swelling, shown by its being dull on percussion and either by fluctuation or by its infiltrating character (a rapid infiltration can only be by gas or by fluid—the percussion note at once distinguishes between these); (*c*) by signs of bruising or blood-staining; (*d*) by the general signs of loss of blood (in some cases); (*e*) in some few cases by evidence of the disturbance of the circulation in the part; and (*f*) by increase in size of the swelling going on for a time at least—this is one of the most important signs of all. Where the escape of blood is arrested and the effusion forms a distinct tumour, it is called a *hæmatoma;* in such cases the blood is usually poured out from smaller vessels. When, however, blood is poured out from a single large vessel, and the opening in the vessel remains patent, so that blood continues to flow, it is spoken of as a *ruptured artery* or *ruptured aneurysm.* These may be thus distinguished:

If the swelling is more or less well defined and circumscribed, at first fluctuating, without pulsation, bruit, or thrill, and there is no interruption of the pulse in the arteries beyond, and especially if it has resulted from direct violence, it is a *hæmatoma.*

If the swelling is ill defined, very tense, of great size, not fluctuating, but more or less boggy at the edges, and the limb beyond is cold, œdematous, livid, and numb, and the arteries pulseless, and if there is severe pain in the part, with perhaps fainting and other general signs of a severe loss of blood, it is a *diffused aneurysm.* A bruit may be heard in such a swelling, at times, a thrill may be felt, and if the parts around the fluid blood are much compressed and condensed into a spurious sac, faint pulsation may be detected; if the artery is partially ruptured there may be a feeble pulse in the arteries beyond. Sometimes the patient experiences a sensation of something snapping or giving way, followed by a hot rushing feeling.

If such a swelling has formed as the result of a severe twist or strain, and there is no previous history of any affection of the vessel, it must be diagnosed as a *ruptured artery.* But if the swelling has occurred spontaneously, or from only slight violence, and there is a history of aneurysm, or of a swelling, or of a sense of beating in the part, or of pain supposed to be "neuralgic," or of venous engorgement below, then it must be diagnosed as a *ruptured aneurysm.* If unrelieved, this condition speedily runs on to *moist gangrene.*

(3) *Traumatic emphysema* is recognized by the softness of the swelling, the crackling sensation when it is compressed, and the resonance to very light percussion.

Extravasation of urine is characterized by the position and limits of the swelling, by its œdematous nature, and by interference with the act of micturition. (*See* p. 633.)

iii. **Swellings arising rapidly** are in all cases due to an accumulation of excess of the animal fluids or of gas in the part, for only these can thus rapidly collect.

Acute inflammation, as it occurs in the cellular tissue, glands, periosteum, tonsil, tongue, larynx, tunica vaginalis, bursæ, synovial membranes, etc., is the most frequent cause of such rapid swelling. It also occurs when a sudden or rapidly formed obstruction to the venous circulation leads to *passive œdema* of a part, as in thrombosis and compression of veins, and it may occur when some profound change in the character of the blood leads to increased transudation of serum, as in acute nephritis. A swelling is rapidly formed, too, when *small blood-vessels are injured* and bleed, as in some bruises; in cases of *obstruction of the ducts of actively secreting glands*, the secretion poured out in considerable quantity may accumulate behind the obstruction and lead to a rapid swelling. Examples of this are so-called "milk congestion," where a mammary lobe is distended with its own secretion, the distension of a salivary gland behind a calculus in its duct, and acute retention of urine. *Emphysema* of the chest, neck, and face may cause rapid swelling in the fasciæ of these parts. The *coagulation of blood in a vein* (thrombosis) may cause a swelling by the clot distending the vein.

Acute inflammation will be readily distinguished by its characteristic local signs: (*a*) redness, when the inflamed part is superficial; (*b*) heat; (*c*) pain, usually severe, and (*d*) tenderness; as well as by general fever.

Œdema is recognized by the pitting of the swollen part on pressure; when a swelling is wholly œdematous it can be entirely obliterated at any one spot by properly applied pressure. If due to venous obstruction, it is limited in area, and there is sometimes more or less lividity of the surface and distension of the veins; if due to altered blood condition, it is general in distribution, there is no lividity, but, on the contrary, marked pallor.

Extravasation of blood is distinguished (*a*) by the discoloration of the part, which cannot be altered by pressure, and which undergoes the characteristic colour changes of a bruise; (*b*) by the ill-defined character of the swelling; and (*c*) by the history of an injury or strain.

A *distended gland* or *viscus* is recognized (*a*) by the position of the swelling; (*b*) by the outline of the swelling corresponding to that of the gland or viscus; (*c*) by the influence of secretion in causing the swelling, e.g. the enlargement of a salivary gland at each meal when its duct is obstructed by a salivary calculus; and (*d*) by the effect of removing the contents of a viscus, as by siphoning the stomach in dilatation of that organ, or by catheterism in retention of urine.

A *venous thrombus* is characterized (*a*) by its position in the course of a vein; (*b*) by its cylindrical shape, with or without rounded projections corresponding to pouchings of the vein; and (*c*) by its firmness. The manipulation of a suspected thrombus must be very gentle, lest part or all of it be detached.

iv. **Swellings slowly formed,** or **chronic swellings,** may be caused by accumulation of the fluids of the part, or by an increase of the formed elements, or by both. Thus, such swellings are caused by (1) chronic inflammation; (2) œdema due to gradually produced alteration in the character of the blood or to obstruction to the venous circulation; (3) yielding of vessels to intravascular pressure, e.g. aneurysm, varix; (4) accumulation of secretion in a closed sac, or behind an obstructed gland-duct, e.g. cysts, galactocele, synovial effusions; (5) gradual displacement of organs, e.g. spinal curvature, exophthalmos, many herniæ; (6) hypertrophy, e.g. of mamma, tonsil; (7) tumours proper, or new growths.

Chronic inflammation is generally characterized by (*a*) gradual increase of the swelling; (*b*) its infiltrating character; (*c*) pain especially elicited by pressure on, or by use of, the part; (*d*) in some cases, local heat; (*e*) alteration in the consistence of the tissue, either induration or softening; (*f*) impaired function of the part; (*g*) in some cases, pyrexia. To distinguish between the results of chronic inflammation and hypertrophy is oftentimes a matter of very great difficulty.

Œdema, when chronic, has the same characters as when acute. But one variety, the so-called "solid œdema," does not pit on pressure (*see* p. 251).

Dilatation of an artery is to be recognized (*a*) by the position of the swelling in the course of, and fixed to, an artery; (*b*) by expansile pulsation in the tumour synchronous with the ventricular systole, often accompanied by a bruit and a thrill; (*c*) by shrinking of the swelling when the artery on its cardiac side is compressed; and (*d*) by weakening and delay of the pulse in the artery beyond. (*See* p. 280.)

Dilatation of a vein is known by (*a*) the position of the swelling in the course of a vein or veins: it is most common in the veins of the lower limbs, spermatic cord, and anus; (*b*) the elongated and often tortuous or sacculated character of the swelling; (*c*) its compressibility and reducibility; (*d*) where superficial, the livid colour of the enlargement. When there is a direct communication between an artery and the dilated vein, the latter exhibits pulsation, bruit, and thrill. (*See* p. 282.)

Accumulation of secretion is recognized (*a*) by the occurrence of the tumour in the position of, or actually in, a gland or closed sac; (*b*) by its more or less globular outline; (*c*) in some cases by the fluidity of its contents as evidenced by fluctuation; (*d*) by the absence of the usual signs of inflammation; (*e*) by the nature of the contents of the swelling, obtained by an exploratory puncture.

Displacement of organs. (*See* p. 236.)

Hypertrophy most often occurs congenitally, or in early life. Its general features are (*a*) uniform painless enlargement of the part or organ, which after attaining a certain size remains stationary; (*b*) unaltered consistence; (*e*) the function of the part is not interfered with, except in some cases from its mere bulk; (*d*) absence of heat, of redness, and of degenerative changes.

New growths vary very much in their features, but they are to be generally recognized by (*a*) their continuous growth, which may be slow or rapid: some tumours may become stationary; (*b*) the abrupt limitation of their outline; (*c*) absence of local heat, redness, pain, œdema, and fever: exceptions in all these particulars are met with; (*d*) apparently spontaneous formation; (*e*) resistance to treatment other than excision and "radiations."

v. **Traumatic swellings.**—In many cases a swelling more or less directly follows an injury. Injury can cause swelling (*a*) by *displacement of parts*, as in hernias, fractures, and dislocations; (*b*) by *rupture of vessels*, as in fractures, bruises, hæmatoma, and aneurysm; (*c*) by exciting *inflammation* or leading to infection, as in acute orchitis from a blow, and in abscess following a puncture or wound; (*d*) by the *effusion of plastic lymph* in the process of repair, as the callus around a fracture; and (*e*) by exciting the *development of a new growth.*

vi. **Intermittent swellings.**—Intermittent appearance is a not infrequent characteristic of swellings caused by *displaced viscera* or *structures*, as hernias, rectal polypus, prolapsus ani, and prolapsus uteri; by *slight œdema*, as in the swelling of the ankles noticed only in the evening; and by *venous distensions*, e.g. varices appearing only during pregnancy, and piles.

2. The **progress of a tumour** is another fact of great importance. Attention should be paid to several particulars:

i. A tumour may **remain stationary** even for years; this of course indicates an entire absence of formative activity, and is chiefly of importance as evidence of the absence of "malignancy" and of active inflammation. A tumour long stationary may again enlarge, as when inflammation attacks a caseated gland, or if a simple tumour becomes "malignant," as when a wart or a mole develops into an epithelioma or a melanoma.

ii. A tumour may **diminish in size.** This, too, is usually a favourable sign. If *gradual*, it indicates absorption of the elements of the swelling, whether fluid, as blood, serum, and pus, or solid, as granulation tissue, fibrin, bone; or a shrinkage from some retrograde nutritive change, as in the caseation and calcification of tuberculous glands, and the contraction of "withering scirrhus." If it occurs *suddenly*, it indicates either the escape of the fluid contents of the swelling, as in some cases of hydronephrosis and in rupture of an ovarian cyst; or the replacement of a displaced viscus, as in the "reduction" of a hernia.

iii. A tumour may **suddenly increase in size.** This is caused by the onset of *acute inflammation* in or around it, e.g. an inflamed pile; by *effusion of blood or serum* into it, as when a hydrocele becomes a hydro-hæmatocele, or a hernia becomes strangulated, or an ovarian cyst becomes congested by twisting of its pedicle; or by increased *displacement of organs*, as in hernia.

iv. A tumour may **continuously increase,** and this increase may be slow or rapid. The rate of increase depends upon the relation between the intensity of the cause of the enlargement and the resistance to that enlargement. Where the swelling increases *slowly*, it is due either to a *feeble tendency to enlargement*, as in chronic inflammation and in the more benign tumours, or to *considerable resistance to enlargement*, as in aneurysm, varix, and intra-osseous tumours and inflammations. Where the swelling increases *rapidly* it indicates a *great inherent power of growth* in the tumour, as in acute inflammation, soft malignant tumours, and some cysts, or a *feeble resistance* to enlargement, as in œdema of cellular tissue. A continuous enlargement of a solid tumour without alteration in consistence is an important characteristic of malignant disease.

v. A swelling may **enlarge intermittently.** This is met with in (*a*) *displacement of viscera:* under the influence of strain further displacement occurs from time to time, as in hernia and prolapsus ani; (*b*) *successive attacks of inflammation*, as in some cases of adenitis and tonsillitis; (*c*) *vascular enlargements*, either active or passive, as in exophthalmic goitre, where it is due to intermittent arterial dilatation, or in varix, where it is the result of intermittent venous obstruction, e.g. successive pregnancies.

vi. A tumour may **change its position.** This is observed in fatty tumours, which have been known to travel in the subcutaneous tissue of the back from the shoulders towards the buttock; the movement is never in a direction contrary to gravity. More often we see that as a tumour enlarges it *appears* to change its position, owing to the growth taking place in one special direction. Thus, an inguinal hernia may at first cause a swelling in the groin, but as it enlarges it passes into the scrotum, and so distends it that the small inguinal swelling is obscured.

vii. The **direction in which a tumour enlarges** is often a matter of considerable diagnostic value. It is either an indication of the direction of least resistance to the growing tumour, and so shows its relation to some of the stronger and more resistant fasciæ of the part, as in psoas and iliac abscess, hernia, extravasation of urine, synovitis, bursitis, and many other tumours; or it indicates the affection of some particular tissue, as in diffuse lipoma, where the fatty tissue alone is involved, in lymphadenoma, where lymphatic glands alone are enlarged, and in varicose veins.

3. **The mode of growth.**—A tumour may enlarge in one of three ways: either by the continuous expansion of the primary swelling; by the invasion of the tissue around it; or by the development of separate swellings, which become incorporated with the original growth. The first is exemplified in the growth of aneurysms, cysts, and lipomata. The second is seen in cases of malignant tumour—the infiltrating mode of growth is one of their most important features; and the third form is seen in

some cases of cancer, especially cancerous glands, also in lymphadenoma, gummata, lupus, and actinomycosis.

4. The **pathological changes** occurring in a tumour may aid in the diagnosis.

A tumour, as it enlarges, may **ulcerate.** Two varieties of this ulceration are to be distinguished. In some cases the skin over a large tumour ulcerates, either from distension or from constant friction. In such cases the skin is thinned, the swelling is always very large, and the ulceration of the mass is not deep. In cases of the other class the ulceration is caused by molecular disintegration of the tissue of the tumour itself, and is therefore independent of the size of the mass, and is an important indication of the vital condition of the tumour. Such ulcers are deep, or at any rate not limited to the skin, and involve the tumour itself; the skin, or mucous membrane, is adherent to and involved in the mass, and often there is more or less fungous protrusion of the growth. We see illustrations of this in cases of epithelioma and other carcinomata, sarcomata, gummata, lupus, actinomycosis, etc.

A swelling may **alter in consistence,** becoming firmer or softer. (i) *Increased firmness* may be due (*a*) to increased tension, in which case it is always accompanied by enlargement of the swelling, e.g. hydrocele, strangulated or obstructed hernia, ovarian cyst with twisting of its pedicle; (*b*) to solidification of fluid contents, as the coagulation of the blood in a hæmatoma or an aneurysm, or thrombosis in a varix; (*c*) to organization of a softer cellular exudation or growth, e.g. ossification of callus, of a node, or of an enchondroma; (*d*) to absorption of the fluid parts of swellings, e.g. resolution of inflammation; or (*e*) to calcification of a thrombus. In the last three instances, except in the case of enchondroma, the induration is accompanied with shrinking of the swelling. (ii) *Softening* of a swelling is due (*a*) to liquefaction of its solid parts, as in the formation and progress of an abscess, and in the disintegration of tumours; (*b*) to destruction of firm, resisting structures, e.g. bone and fascia, as in the growth of central tumours of bone—in these the softening is attended with increased size of the tumour; or (*c*) to lessened tension from absorption, as in serous and synovial effusions—this is associated with lessened bulk of the swelling, and indicates resolution. Cysts may form as a tumour grows; we see this in the progress of cystic adenoma or cystic sarcoma of the breast, and in cystic degeneration of uterine myoma.

5. **Evidence of malignancy.**—Malignancy may be *local* or *remote*. An infiltrating mode of growth, shown by the incorporation of the surrounding tissues with the circumference of a swelling, and the occurrence of small detached nodules of tumour around the main mass, are the usual signs of *local* malignancy. Local recurrence of a tumour after apparently complete removal is also due to the same cause. The results of *remote* malignancy are seen in secondary swellings in the lymphatic glands in connexion with the part, and in the lungs, liver, and other tissues and organs. Evidence of the infective nature of a swelling is of the utmost importance in the diagnosis of carcinoma, sarcoma, certain granulomata and papillomata, and some other conditions. It is important to remember that carcinomata infect primarily through the lymphatics, while sarcomata as a rule infect through the blood-vessels. Sarcoma of the tonsil and periosteal sarcoma of long bones form notable exceptions to this rule, infection in them being through lymphatics.

IV. EFFECTS OF TUMOURS UPON THE SURROUNDING TISSUES

Reference has been made to the locally infective influence of some swellings, and to the infiltration of surrounding tissues that is a distinguishing feature of all inflammatory, granulomatous, and malignant growths. The other local effects we have now to study are what are often spoken of as **pressure effects.**

Pain.—The pain of tumours depends upon three chief factors: the seat of the swelling—whether it has formed in a sensitive part or near nerve-trunks; the tension of the swelling, and whether this has been slowly or rapidly attained; and the infiltrating character of the swelling. Where nerve-trunks are involved the pain is referred to the terminal distribution of the nerves, often at some distance from the swelling, e.g. pain in the hand from a bulbous nerve in the arm, pain in the foot from a popliteal aneurysm, pain up the side of the head from malignant growth in the neck. Where the pain is caused by the involvement of nerve terminals it is local, and varies with the rapidity of the destruction of the nerves; in acute inflammation it is always present, is intensified by posture or use or any condition that adds to the engorgement of the part—when acute suppuration occurs the pain often becomes throbbing in character. The influence of tension is exemplified by the acute pain when the pedicle of an ovarian tumour becomes twisted, by the pain attending the growth of a tumour or an abscess within bone, and its relief when the disease has extended through the bone, and by the pain in a thrombosed pile. The slow displacement of parts is as a rule painless, as evidenced in the case of large lipomata, cysts, and uterine fibroids, while the influence of an infiltrating growth destroying the nerve terminals is seen in the pain attending many cases of malignant disease.

Muscular spasm and paralysis.—Spasm from pressure upon a nerve is rarely if ever seen, but paralysis often results, and has especially serious effects in the case of the eye and the larynx. Facial palsy from a malignant growth in the parotid gland, and palsy of half the tongue from a carotid aneurysm, are other familiar examples.

Absorption of tissues.—By the growth of various swellings, connective and other soft tissues are stretched, thinned, and absorbed, and even bone is expanded and absorbed by aggressive growths. The absorption of bone may cause great deformity, as when the spinal column collapses, or spontaneous fracture of the shaft of the femur occurs, or the facial bones are expanded.

The **arterial pulse** on the distal side of a tumour should always be noticed. In the case of an aneurysm the pulse in the vessel beyond is delayed and rendered smaller and of less tension than in the corresponding artery of the other side. These differences are usually quite perceptible to the finger, but the alteration of tension can be best demonstrated by a carefully taken sphygmographic tracing. Sometimes, beyond an aneurysm, the usual arterial pulse is entirely lost from embolism or thrombosis, or from the tumour obliterating the mouth of an artery. The complete subcutaneous rupture of a main artery is always attended with the abolition of the arterial pulse below.

The pressure of a tumour often displaces an artery and occasionally compresses it, but is rarely sufficient to occlude its lumen.

Venous engorgement, as indicated by the dilated veins coursing over the part, or by its general lividity, is an important indication of an intimate connexion of a swelling with the vascular system. It is well, however, to remember that the association may be entirely accidental, as in the case of a fatty tumour of the thigh associated with varicose veins of the leg; inquiry as to the time of appearance of the swelling and of the venous distension will generally be sufficient to eliminate this error. The direct connexion of venous distension and swellings is fourfold:

1. *Venous distension may be the cause of the entire swelling.* In this case the swelling will have the outline of dilated, convoluted, and sacculated tubes, and is entirely reducible unless the contained blood has coagulated.

2. *The venous distension and the swelling may be produced by one common cause,* e.g. obstructive or regurgitant heart disease. In this case the swelling is œdematous.

3. *The venous distension may be produced by the swelling obstructing the return of blood,* either by compression or obliteration of a vein or veins by the growth, or by a communication between an artery and a vein, the flow of the arterial blood into the vein impeding the venous return: examples of the former are seen in popliteal and other aneurysms, and in mediastinal and other growths. In these cases the venous distension is on the distal side of the swelling, and may be accompanied by more or less œdema.

4. In other cases it is due to *increased blood supply necessitating enlargement of the efferent veins.* This is observed in very vascular growths, where the original calibre of the veins is not sufficient to carry off the great amount of blood conveyed to the part.

In such cases the venous distension is noticed over and on the cardiac side of the swelling. As these growths may also obstruct the deep veins, some part of the venous engorgement may be explained by this fact. These very vascular new growths are often malignant, and the blue veins coursing over a swelling are of some diagnostic value. Uterine fibroids are examples of very vascular benign tumours, and the enormous veins seen running from them are the result of this vascularity. Enlarged veins are occasionally seen in cases of chronic abscess.

Lymphatic œdema.—A word must be said about the œdema that is met with as the result of obliteration of lymphatics as well as of veins in cases of malignant disease of the axilla and root of the neck or of the groin. There may be little or no lividity with it; the skin may be considerably thickened and irregular, or soft and thinned; in some cases the œdema is very firm and pits with difficulty or not at all.

Pressure effects are of great value in diagnosis in indicating the position and relations of a swelling, and also in showing what may be called the aggressive character of a tumour.

V. The Patient

The **age** of the patient is of importance in the diagnosis of tumours. In *infancy* we meet with congenital tumours of all kinds, such as nævi, dermoid cysts, cystic hygroma, spina bifida, meningocele, and encephalocele; swellings resulting from congenital malformations, such as hernia and hydrocele; swellings due to inherited syphilis or to rickets; and occasionally with fatty tumours and sarcomata. In *childhood and youth* glandular enlargements, abscesses acute and chronic, and cartilaginous and bony tumours are most common. In *early adult life* venereal affections, traumatic and inflammatory swellings, together with fatty, mucous, and fibrous tumours, prevail. And in *late adult life* malignant tumours of all kinds, and other senile swellings, such as those of rheumatoid arthritis, of adenoma of the prostate, and hydrocele, become common. Age is of most direct value at the two extremes, in aiding the diagnosis of congenital tumours and of malignant tumours.

Sex seems to have little or nothing to do directly with the etiology, and therefore the diagnosis, of tumours, apart from the affections of the organs peculiar to the two sexes. Aneurysms, with the exception of those of the carotid artery, and cancer of the lips and tongue, are much more frequent in men than in women, but this is not due primarily to sexual difference.

The **occupation** of the patient has occasionally some bearing upon the diagnosis of a tumour or swelling: those who handle hides are liable to malignant pustule; workers in stables are more prone than others to glanders and to actinomycosis; workers in tar, paraffin, aniline, and X-rays are prone to develop cutaneous epithelioma.

The **previous history** of the patient may aid in the diagnosis of tumours. The history of tuberculosis, of syphilis, of hæmophilia, or of leukæmia may throw great light upon the nature of a solid tumour or an effusion of blood. In the malignant diseases, such as sarcoma and carcinoma, light may be thrown upon the nature of a secondary tumour arising after the removal of the primary focus of disease; thus, when a cancerous tongue has been excised, a progressively enlarging gland in the neck will not be mistaken for a tuberculous gland or some other simple tumour. In the diagnosis of pregnancy, whether intra-uterine or extra-uterine, the history may be important.

Concomitant affections are frequently of special value in the diagnosis of tumours. This association may be twofold. Tumours may accompany other lesions produced by the same disease, both resulting from some common cause; the best examples of this are found in syphilis, where the existence of the characteristic ulcerations of the skin or mucous membranes, of nodes, of necrosis of the bones of the nose or of the skull-cap, etc., greatly simplifies the diagnosis of a gumma. The association of exophthalmos with goitre, and the coincident enlargement of many groups of glands, aid in the diagnosis of Graves's disease or of lymphadenoma. The presence of tuberculous disease of the lungs may simplify the diagnosis of a tuberculous testicle.

In other cases the tumours are secondary to the local affections. As examples of this may be mentioned glandular swellings, such as those in the groin from an abrasion on the foot, chancroid, urethritis, soot-wart or epithelioma of the penis, those in the axilla from inflammation or carcinoma of the mamma, those in the neck from pediculi capitis, otorrhœa, tonsillitis, facial chancre, epithelioma of lip, tongue, pharynx, or larynx. Other examples are furnished by the association of chronic epididymitis or of perineal abscess with stricture of the urethra, of albuminoid liver with old sinuses, or of cancer of the liver with cancer of the rectum; of swellings of bone with scirrhus of the breast, of a tumour of the skull with a bronchocele.

Cachexia is rarely of importance in the diagnosis of the nature of a swelling. It is known to be the result and not the cause of malignant disease, and usually develops at a time when the nature of an external growth is quite evident from its local characters. There are, however, cases of internal cancer in which the cachectic condition of the patient may aid the diagnosis.

VI. Exploration of a Tumour

It is often necessary to explore a swelling before such an accurate diagnosis can be made as will form a basis for treatment.

1. In its simplest form exploration consists in **puncturing the swelling** with a sterilized syringe armed with a suitable needle. By this means we can determine in doubtful cases whether the swelling is solid or fluid, and, if fluid, what proportion of the swelling is fluid; and any fluid obtained can be submitted to examination. Such exploration is of value, e.g. in diagnosing a small deep-seated cyst in the mamma from a solid tumour, or a very soft sarcoma from a fluid swelling; it enables us to recognize a hydro-sarcocele and to feel the enlarged testicle after the tunica vaginalis has been emptied.

2. The second form of exploration is by an **incision** down to, and in some cases into, the swelling. When this is done a portion of the periphery of the swelling or a separate nodule can be removed for further examination. By this means we can learn the exact seat of the swelling, its relations, its mode of growth—encapsuled or infiltrating—the presence or absence and the extent of adhesions; and by subsequent examination of parts removed we can determine the actual structure of a growth, and in some cases the presence of specific micro-organisms. This method is employed chiefly in cases of abdominal swellings, but is sometimes necessary in tumours of the limbs, jaws, bladder, brain, and spinal cord. Whenever it is desired to examine microscopically

the structure of a solid "growth" a piece of its growing edge should be cut out; the examination of such a fragment as can be obtained by the use of the harpoon, or by scraping a surface, rarely affords a satisfactory result; if a portion of apparently healthy tissue around the growth is removed with it, the pathological examination can be carried out with more success. It must be borne in mind that diagnosis by microscopical examination is not always easy, and may be quite impossible unless a sufficient and well-chosen portion of the tissue to be examined is removed.

Examination of parts removed.—This may be chemical, microscopical, or bacteriological. By these means we are enabled to distinguish the contents of various fluid and cystic swellings—serum, mucus, urine, cerebro-spinal fluid, saliva, pancreatic fluid, hydatid, ovarian, sebaceous, dermoid fluid, pus, milk, blood, altered blood, tuberculous fluid, etc. The various forms of solid tumours—inflammatory, sarcomatous, cancerous, and others—are to be identified; and the presence of pathogenic organisms—septic, tuberculous, mycotic, and the rest—can be recognized. By these examinations a precision of diagnosis can be obtained which is often impossible by other methods. For particulars of the conduct of these examinations the student is referred to manuals of Clinical Chemistry, Pathology, and Bacteriology.

CHAPTER XVIII

DIAGNOSIS OF GENERAL SWELLINGS

In other chapters the diagnosis of fluctuating and of pulsating tumours, and of those met with in special regions, is discussed, and it falls to us to speak here of those swellings which have not these special features and which occur more or less generally over the body. The method of examination described in the previous chapter should be followed: the surgeon should (1) determine *what tissue* (or tissues) *the tumour is connected with*, then note (2) its *physical characters*, and (3) its *vital characteristics*. These points have been considered in the previous chapter, and the reader is supposed, in what follows, to have studied that chapter.

I. **Tumours of the skin.**—1. If the tumour is an outgrowth from the skin, entirely raised above its surface, and therefore clearly marked off at its attached base, firm, dry (unless in a situation where it is kept moist by secretion), granular or branched on the surface, it is a **wart** or **papilloma.** These vary much in appearance, according to whether the branching processes of which they are composed are more, or less, blended together, and according to the density of their tissue.

2. If the tumour is multiple, sessile, with a moist, excoriated, or superficially ulcerated surface discharging an acrid watery secretion, it is a **mucous patch** or **condyloma.** These are found at the corners

of the mouth, around the anus and vulva, and on the penis and scrotum; other evidences of secondary syphilis are always present. The diagnosis is made certain by detecting the *Spironema pallidum* in a drop of the fluid from the surface.

3. If the tumour is fixed to and infiltrates the skin, and spreads both laterally and deeply, is firm, ulcerated on the surface, the ulcer having thick everted edges, an irregular granular base, and a serous discharge, and if the lymphatic glands of the part are enlarged, hard, and progressively increasing in size, it is an **epithelioma.** It is in the early stage of an epithelioma, before ulceration or glandular enlargement has occurred, that diagnosis is both difficult and most important. The significant features are the extension of the disease into the corium and its spread at the edge. If a portion of the edge of the nodule together with some of the healthy skin is cut out, and a section is examined with a microscope, the downgrowth of the epithelium into the corium and the presence of characteristic cell-nests will establish the diagnosis.

4. A flat plaque in the skin of the face of a person past middle age, slightly raised above the surface, a little yellow or dark in colour, and very slowly extending, is an early **rodent ulcer.** After a time the plaque ulcerates in the centre.

5. If the tumour, usually multiple, is a small nodule raised above the surface, globular or ovoid in shape, of a glistening white colour like white wax, umbilicated in the centre, firm and fixed in the skin, it is **molluscum contagiosum.** The diagnosis can be established by microscopical examination of the contents.

6. If the tumour takes the form of a pedunculated pendulous outgrowth of the skin, soft, elastic, and

smooth, it is called **molluscum fibrosum.** When of large size, or exposed to friction, these growths may ulcerate on the surface. (*See also* p. 261.)

7. But when the swelling is in the form of pendulous folds of firm thickened skin and subcutaneous tissue hanging from the scalp, buttocks, back, shoulders, and thighs, while sometimes called by the same name as the pedunculated variety described above, it is better known as **diffuse fibroma.** Both forms are very chronic in their course, and do not recur after complete removal.

8. If the tumour is dark brown or black in colour, and is growing steadily, it is a **melanoma.** The disease often starts in a pigmented mole, and the progressive enlargement is the sign of the malignant change. It may arise in apparently normal skin or mucous membrane, e.g. in the hand, foot, vulva, penis, scrotum, anus. Secondary growths, also pigmented, in lymphatic glands and numerous metastatic growths in the skin, liver, and other viscera occur very early. Melanuria may be present.

II. **Tumours of cellular tissue.**—1. If the tumour is ovoid or rounded in shape, lobulated on the surface, with a shallow rounded edge, and is freely movable in the subcutaneous tissue, it is a **lipoma.** When such a tumour is gently compressed its lobules may show through the skin and cause an appearance of dimpling, which must be distinguished from the dimpling due to actual adhesion to the skin. The depth at which lipomata occur affects their appearance: the most superficial tend to become polypoid, the deepest have their lobules concealed by the overlying fat. These growths are most common on the posterior part of the body, and about the shoulders and waist. They are not infrequently multiple, and may be very numerous; they vary in size within wide limits, are usually painless, and often remain stationary for years. They have been known to change their position, moving downwards.

The name of Dercum's disease is given to the condition where several lipomata are present, all of which are painful and perhaps tender.

2. If the swelling is soft, granular, or lobulated, adherent to the skin but without a distinct edge, movable over the deeper parts, but not movable in the subcutaneous fascia, it is a **diffuse lipoma**; this is most common as "double-chin," or at the back of the neck, or over the mastoid process, or in the belly wall.

3. A similar tumour, soft, lobulated, incompressible, but placed beneath the deep fascia and connected perhaps with a muscle, or bone, or nerve, is a **congenital lipoma.**

The feature by which fatty tumours are to be recognized with most confidence is the soft lobulation of their surface.

4. If the tumour is congenital in origin, irregular in outline, soft and loose, but incompressible, with parts that fluctuate, and others that are solid, it is a **cystic hygroma.** These tumours are most common in the neck, axilla, and groin, close to the deep vessels; they are often multiple and may attain a large size; they are liable to repeated attacks of acute inflammation. In some cases this tumour occurs in the form of a single lax serous cyst.

5. If the tumour yields gradually (not suddenly) under compression, without any gurgle or slip, such as is common in hernia, and then at once fills out again when the pressure is removed, and becomes tenser and fuller when the patient cries, strains, or makes any expiratory effort, it is a **nævus.**

The diagnosis may be rendered very easy by the nævoid condition of the skin over the tumour, or by its blue colour showing through the thin skin. Nævus is a congenital formation, or appears soon after birth; it may be stationary, or grow with various degrees of rapidity, or undergo spontaneous recession and cure. Although these swellings are largely fluid they do not fluctuate, and as they are connected with veins they do not pulsate. They may be met with in any region.

6. If a tumour with the characters of a lipoma is found to yield slightly to pressure and at once to fill out again when the pressure is removed, it is a **nævo-lipoma.** A congenital origin, and a nævoid condition of the covering skin, aid in the diagnosis of this condition.

7. If the tumour is soft, less well-defined and not so distinctly lobulated as a lipoma, and is growing steadily, it is most probably a **myxoma.**

8. If the tumour is firmer, grows rapidly, and shows by its fixity a tendency to infiltrate not only the fascia in which it grows, but neighbouring parts, it is a **sarcoma.**

9. A small round or ovoid tumour in the course of a peripheral nerve, moving freely transversely to the direction of the nerve, pressure upon which causes pain or a sense of "pins and needles" in the peripheral distribution of the nerve, is a **neuroma-fibroma.** A similar tumour may be found on the proximal end of a nerve in an amputation stump, or in any case where a divided nerve has failed to unite. When multiple neuromata occur on the cords of a plexus or on the branches of a nerve the condition is known as **plexiform neuroma.** A neuroma may also occur as a small nodule in the subcutaneous tissue, which is exquisitely sensitive, the least compression causing acute pain; it is then called a **painful subcutaneous nodule.**

10. Multiple small neuro-fibromata scattered over many nerves and associated with either molluscum fibrosum or pigmentation of the skin, or both, constitute **von Recklinghausen's disease.** This disease often occurs in more than one member of a family, and may be accompanied by mental deficiency and softening of the skeleton. The tumours first appear in childhood, but others arise from time to time throughout life. If one or more attain a large size or grow rapidly, they have become **sarcomatous.**

11. If the tumour is infiltrating, subacute in course, with slight redness of the skin over it, firm at first and then softening either wholly or in one or more separate points, it may be **actinomycosis.** The probability is increased if the swelling is about the jaws, face, neck, or abdomen. To establish the diagnosis, the discharge from a sinus or a softened spot should be examined microscopically, and if the club-shaped fungus or a mycelium is found, the diagnosis is established. Many cases of actinomycosis have been regarded in the past as tuberculous or syphilitic, or even malignant in nature, and the existence of this disease must be ever present to the mind of the surgeon if he is not to overlook it. In its mode of onset, its tendency to soften down into abscesses which leave chronic discharging sinuses, it resembles tuberculous disease; in the amount of firm infiltrating growth around the sinuses, its resistance to treatment, the great deterioration of health it induces, its favourite seats, and its frequently fatal termination, it resembles malignant disease.

12. If the swelling is elongated, cylindrical in shape, and in the course and position of a vein, it is a **thrombus.** If the swelling has recently appeared, and is painful and tender, it is a *recent thrombus.* While if to these signs there are added an ill-defined

outline of the swelling, obscuring its original form, and pyrexia, there is also **phlebitis** and **periphlebitis,** which may run on to **suppuration.** In the acute condition there may be more or less œdema of the parts returning their blood through the occluded vein, but this largely depends upon the site of the obstruction. In the case of superficial veins the diagnosis will rest upon the character of the swelling; in thrombosis of deep veins it rests rather upon the occurrence of local œdema, with pain and tenderness along a vein, for the actual swelling of the vessel and its outline cannot be made out, and, owing to the danger of detaching a portion of the clot, only the gentlest manipulation is warranted.

A recent thrombus may be acutely tender, or accompanied by very severe "cramp" in the muscles of the limb and by fever; in other cases there is very little pain or tenderness.

13. Small circumscribed swellings in the subcutaneous tissue, at first firm, but quickly softening into fluctuating collections of thin pus, are **tuberculous deposits.** They are usually but not always multiple, and the various swellings may show the different stages of the disease. The patient, generally a child or an adolescent, often shows other evidences of tuberculous infection. The presence of tubercle bacilli should be sought for bacteriologically.

14. Little tender nodules in the neighbourhood of a joint or over a subcutaneous bone, in the subjects of acute rheumatism—especially young people—are the so-called **rheumatic nodules.** Their disappearance under treatment and the accompanying rheumatic phenomena are distinguishing features.

15. Firm nodules in the subcutaneous tissue which steadily enlarge and become adherent to the skin may be **secondary cancerous growths.** When they

occur around, or after the removal of, an obvious primary cancer the diagnosis is very easily made. They may, however, be the first observed sign of disease; especially is this the case in columnar carcinoma of the intestine, which may be overlooked until a nodule appears at the umbilicus or some other part of the abdominal wall. Similar secondary **sarcomatous nodules** may be met with, and in melanotic sarcoma they are sometimes very numerous.

16. Other tumours met with in cellular tissues are *gumma*, *hydatid*, and, very rarely, that due to *Cysticercus cellulosæ.*

III. **Tumours of lymphatic glands.**—If a swelling occurs at the site of lymphatic glands, and has the ovoid or globular outline of these bodies, and especially if it is multiple, and movable under the skin and over the neighbouring deeper parts, and there is some obvious exciting cause, it may be diagnosed as an enlarged lymphatic gland. It is only in quite a few regions that any difficulty is experienced in arriving at a correct diagnosis that a swelling is glandular, and these cases are discussed in other chapters.

Having concluded that the swelling is glandular, the surgeon must next proceed to determine its nature. To ascertain this he must notice the special features of the glandular swelling, examine for possible sources of infection of the gland, and study the cytology of the blood.

Note the local features of the enlarged gland, particularly its mobility or fixity, the definition of its outline, its consistence, and the state of the skin over it. Infection with staphylococci and streptococci causes an acute swelling of a gland with inflammatory œdema obscuring its outline and fixing it in its fascial bed; staphylococci often cause suppuration with accompanying softening and fluctuation. Syphilitic glands are firm with clearly defined outline, and they are movable in their fascial bed. Tuberculous infection causes a chronic enlargement with periadenitis fixing the gland; there is a tendency to progressive infection of many glands and to softening of those first involved. They may persist as firm or even hard nodes. Malignant disease in glands is characterized by persistent growth, by a marked tendency to infiltrate and to become fixed to neighbouring parts; epitheliomatous glands frequently soften and form large fluctuating swellings.

Examine for a source of infection.—As lymph-glands are parts of a great absorbent system, the area of tissue draining into the gland in question should be first examined to discover any possible source of infection or poisoning, and the nature of a lesion there will probably at once reveal that of the enlarged gland, e.g. an infected wound, erysipelas, syphilitic chancre, follicular tonsillitis, carcinoma, melanoma. As lymph-glands are often enlarged as the result of a general infection, the examination must also extend over the body generally, to discover such possible causes as syphilis, tuberculosis, and cancer.

A differential count of the blood-cells often throws great light upon the nature of an enlarged gland. Excess of polymorphonuclear cells points to staphylococcal or streptococcal infection. Slight lymphocytosis points to tuberculosis. Great excess of lymphocytes combined with diminution of red cells and of hæmoglobin suggests lymphatic leukæmia; while slight secondary anæmia, shown by diminution of red cells and of hæmoglobin without marked alteration in the white cells, accompanies well-established Hodgkin's disease.

1. If the swelling is acute, following an injury or an

inflammation of some part pouring its lymph into the affected gland, and the gland is painful, tender, more or less fixed in the surrounding tissue, and especially if the skin over it is red and œdematous, the disease is **inflammatory**, and is due to pyogenic infection.

2. If the enlargement is chronic, slowly progressing from gland to gland, forming firm, painless, rounded swellings, which exhibit a tendency to slow disintegration, and especially if it occurs in the neck, the condition is to be regarded as **tuberculous.** The great features of tuberculous glands are their chronicity, the periadenitis fixing the glands more or less to the surrounding tissues, the infection of many glands, and the tendency to soften. Variations are met with in all of these features. The disease may be so rapid as to be almost if not quite acute; there may be no obvious periadenitis; the disease may be limited to a single gland; softening may not occur—indeed, the glands may become harder from calcification The blood-count is normal or shows moderate lymphocytosis.

3. If the affected glands are multiple, firm, freely movable in the connective tissues around, not painful or tender, and if the glandular swelling is accompanied by other signs of constitutional syphilis, they are to be regarded as **syphilitic.** In the groin, where they are associated with a sore which may be a hard chancre, the diagnosis rests upon the facts that there are many glands enlarged (in both groins), that they are hard and shotty, not blended together into one ill-defined mass, that they do not exhibit a tendency to suppurate, that they are either accompanied or followed by the usual manifestations of secondary syphilis, that the blood gives a positive Wassermann reaction, and that they yield to antisyphilitic treatment. But when the sore is on the lip or within the

mouth, the associated glandular enlargement in the neck or submaxillary region takes the form of conspicuous, painless masses, the individual glands being matted together. Syphilitic glands are met with during the early secondary stage far away from the primary sore, especially in the posterior triangle of the neck and above the internal condyle (condylus medialis) of the humerus.

4. If a chronic glandular swelling progressively increases, infiltrates, and becomes fixed to the neighbouring tissues, involving the skin, muscle, bone, etc., it is **malignant** in its nature. Malignant disease of glands is usually painful; the tumour may attain a great size; in some cases it softens, bursts, and discharges a pultaceous or watery detritus, and forms a deep ulcer with a tendency to bleed; when softening occurs the skin over the gland becomes red, and the condition may be mistaken for suppuration; apart from softening, too, the skin may be reddened. When the primary disease is inaccessible to examination, or small and symptomless, the enlarged gland may be the first morbid change to be noticed.

5. If the glandular swelling is a primary and chronic growth, affecting many glands and many groups of glands, forming large, rounded, lobulated masses, inconvenient only by their size, steadily and persistently growing, but not showing any tendency to infiltrate surrounding parts, or to soften or suppurate, the disease may be **lymphadenoma (Hodgkin's disease)**, **lymphatic leukæmia**, or **lympho-sarcoma.**

In *lymphadenoma* the enlargement of one group of glands, usually in the neck, precedes by a considerable interval that of succeeding groups, and until late in the disease, the blood picture is unaffected, and then shows some secondary anæmia only.

Lymphatic leukæmia is characterized by the simultaneous appearance of enlarged glands in many parts, and from an early stage by a marked increase in the number of lymphocytes in the blood.

In *lympho-sarcoma* there is early enlargement of other glands in the neighbourhood of those first affected, with steady increase in size, and, as the disease advances, evidences of enlargement of the liver and spleen. Lympho-sarcoma is believed to be a frequent terminal change in chronic cases of Hodgkin's disease.

IV. **Tumours of muscle.**—The common tumours of muscle are gumma, sarcoma, and tuberculous abscess; secondary carcinomatous nodules are not infrequent, and, as rarer swellings, we may meet with actinomycosis, hydatid disease, and myositis ossificans.

1. If the swelling is steadily or rapidly enlarging, and tends to assume a globular or bossy outline, is firm and uniform in consistence, and has a fairly well-defined margin, it is a **sarcoma.** As a rule there is constant pain and considerable interference with the function of the part. The tumour may attain a great size; the skin over it may become stretched, and enlarged blue veins may show through it, but it does not ulcerate until a late period of the disease.

2. If the swelling is firm, ill defined, and shows a tendency to infiltrate surrounding structures such as periosteum, fasciæ, and even skin, and to soften in the centre, it is a **gumma.** This diagnosis will be confirmed by the history or signs of constitutional syphilis, by the Wassermann reaction of the blood, and also by the effects of treatment. The infiltrating character of a gumma is one of its most marked features; it has no tendency to observe anatomical limits; it never reaches the great size of many sarcomata, and after a time it ceases to enlarge, and

degenerative changes—ulceration and sloughing—set in, shown by more or less softening of the lump, blueness of the covering skin, or the formation of characteristic ulcers.

3. **Secondary carcinomatous nodules** are recognized by their steady growth, their firmness, their tendency to infiltrate and become adherent to adjacent structures, and by the evidence of the primary disease.

4. If the swelling is chronic, painless, smooth, tense, fluctuating, and involving all or nearly the whole of the muscle, it is a **tuberculous abscess.** Psoas abscess is the most common example of this affection. The detection of rigidity or angular curvature of the spine would aid in the diagnosis.

5. If the swelling is chronic, limited in extent to a part of the muscle, tense, fluctuating, stationary, or only very slowly enlarging, and there is an increase in the eosinophile blood-cells, it is a **hydatid cyst.** If the patient is a resident in a country such as Australia, where hydatid disease is common, this diagnosis is made with confidence.

6. For the diagnostic features of *actinomycosis*, *see* p. 261.

7. If the swelling in a muscle or tendon is hard and unyielding, and opaque to X-rays, it is due to **myositis ossificans.** (*See* Plate v., Fig. 2, facing p. 324.) This may be the result of an injury, particularly the laceration of a muscle where attached to bone, and the opaque bone may be seen either in a tendon or spreading into the muscular tissue from the underlying bone. (*See also* p. 325.) When *idiopathic* it is met with first in the scapular muscles, but may extend widely and cause serious loss of movement, and, if the respiratory muscles are affected, death from broncho-pneumonia.

CHAPTER XIX

DIAGNOSIS OF FLUCTUATING SWELLINGS

THE detection of fluctuation in a swelling indicates its fluid nature, but tells us nothing with regard to the character of the fluid contents. In this chapter we propose to study how the nature of a fluid swelling may be determined.

The fluids that may be met with in swellings are blood; inflammatory exudations—serous, synovial, purulent; cystic fluids of various kinds; retained secretions—urine, bile, mucus; and softened tuberculous, mycotic, carcinomatous, and sarcomatous tissue.

To distinguish between these various fluids the following points must be borne in mind:

1. **The exact seat of the swelling.**—i. If this corresponds to a serous or synovial cavity, the fluid is either blood or some form of inflammatory effusion, e.g. hydrocele, hæmatocele, synovitis, bursitis, hydrocele of a hernial sac.

ii. If it corresponds to a fluid-containing hollow viscus, such as the urinary bladder or the gall-bladder, the fluid is almost certainly the natural secretion found there, such as urine, bile, or mucus. In the urinary bladder blood may be mixed with the urine, in the gall-bladder pus may be formed.

iii. If the swelling corresponds in position with a secreting gland, it is caused by the retention of the more or less normal secretion of the gland; as examples of this condition may be cited hydronephrosis, ranula, sebaceous cyst, cystic bronchocele, galactocele, and involution cysts of the mamma.

iv. If the swelling corresponds in position to a fœtal tubular structure or to the line of union of fœtal folds, it is very often due to secretion into such a tube, or into a cavity left by the partial obliteration of a tube, or by the imperfect blending of the folds, e.g. thyro-glossal cysts, branchial cysts, dermoid cysts, encysted hydrocele of the epididymis or spermatic cord, parovarian cysts, spina bifida.

v. If the swelling corresponds to a lymphatic gland and is acute, it is pus; if chronic, it is softened tuberculous or cancerous débris.

vi. If it occupies the sheath of a muscle, it is generally tuberculous, occasionally hydatid fluid.

vii. If the swelling is near a joint, it is most probably either a synovial cyst or a tuberculous abscess.

2. **The history of the swelling.**—i. If noticed at birth, or quite soon after, the swelling is very probably the result of *congenital malformation*, such as spina bifida or cystic hygroma. Many cysts resulting from congenital malformation may not manifest themselves until some years after birth, e.g. dermoids, but the earlier in life any cyst appears the more probable is its congenital origin.

ii. If the swelling has followed immediately upon an *injury* it is due to the escape of blood—hæmatoma; signs of bruising would confirm this diagnosis. In the case of synovial membranes it must be remembered that inflammatory effusion—synovitis—may ensue very rapidly after an injury; thus a joint cavity may be found tensely filled with fluid a few hours after a sprain. Where a blood effusion follows rapidly after a slight injury it is probably due to hæmophilia, and careful inquiry into the history of the patient and the male members of his family should be made.

iii. When the swelling has formed rapidly and has steadily increased, and has been attended with the signs of inflammation—redness, local heat, pain tenderness, pyrexia, and polymorphonuclear leucocytosis—it is an acute *abscess*.

iv. When the swelling has slowly formed and enlarged, it results from the slow accumulation of the fluid secretion from a cyst wall, or from a very low grade of inflammation of a serous or synovial membrane, or from the slow disintegration and liquefaction of a tuberculous, mycotic, or malignant growth, e.g. cysts, chronic hydrocele, psoas abscess, a cancerous gland.

v. In some cases there is a history of a long-standing swelling suddenly or rapidly becoming larger and tenser; this may be due to a sudden exudation into it, or to a sudden obstruction to outflow from it, e.g. a strangulated ovarian cyst, hydrocele into a hernial sac, retention of urine in bladder or kidney, distension of gall-bladder.

vi. In some cases there is a history of an intermittent swelling—appearance and disappearance—indicating the recurrence of a temporary cause, which is almost always obstruction to the outflow of secretion, e.g. intermittent hydronephrosis, or a periodic increased secretion behind an incomplete obstruction, e.g. distension of a salivary gland behind a calculus during eating.

3. **The accompanying morbid phenomena.**—These, of course, vary a good deal. i. In the case of **joints,** grating on movement and lipping of articular surfaces pointing to osteo-arthritis would indicate that an adjacent fluid swelling was a

synovial cyst; stiffness of the joint, pulpy swelling of the synovial membrane, apparent enlargement of the bones, and great muscular wasting would point to the tuberculous nature of a fluid swelling of the part; the presence of gonorrhœa would suggest the gonorrhœal nature of a synovial effusion; whilst the recognition of an obvious infected condition of the teeth-sockets, i.e. pyorrhœa alveolaris, or of the intestinal tract, e.g. appendix abscess, or of the female pelvic organs, e.g. leucorrhœa, would similarly lead to the diagnosis of an infective arthritis.

ii. In the case of **lymphatic glands** there may be some obvious primary affection which will throw light upon the nature of the secondary glandular disease, e.g. gonorrhœa, chancre, erysipelas, pediculosis, carcinoma. In other cases, while some glands form fluctuating swellings, others show an earlier stage of the disease—firm, more or less fixed glands—from which the tuberculous nature of the disease can be recognized.

iii. Other examples of the value of concomitant affections in diagnosis are—spinal caries and secondary abscess, signs of pleural effusion combined with a fluctuating swelling in the chest wall, and the presence of gonorrhœa with an acute distension of tendon-sheaths.

Very soft malignant growths may give a sense of fluctuation indistinguishable from that given by fluid swellings. In other cases malignant growths soften down into spurious cysts, or are associated with the development of cysts. In all these cases it is very important to recognize the essential character of the tumour, and not mistake it for an abscess or a simple cyst. The chief point to attend to is the want of uniformity about the swelling. Fluctuation is only noticed at one part, or is more distinct at one part than another, showing that the swelling is not wholly fluid. Again, a firm edge or a more or less marked nodulation of the growth can sometimes be felt, which is inconsistent with a cyst. The fixity of the tumour may be greater than is usual in cysts. Special changes, such as expansion of bone, egg-shell crackling, spontaneous fracture, and the like, may aid in the diagnosis.

Cysts and **chronic abscesses** are often difficult to diagnose from each other. They are apt to occur in the same situations, as, for example, in glands and near joints, and in chronic abscess there is often an absence of all inflammatory phenomena. As a rule *cysts* are more tense than chronic abscesses, and, as a consequence, they are more globular in outline. They have also a more clearly defined limiting wall or sac, over which the surrounding tissues can be moved; and their history is often of longer duration than that of an abscess, and marked by a period in which there has been no increase in size. *Chronic abscesses*, on the other hand, are almost invariably tuberculous in nature, and other evidences of tuberculosis may be present They are not separable from the adjacent tissues, and this fixity of an abscess, which is an invariable phenomenon, is of great assistance in diagnosis; for, while some cysts form in fixed structures, the great majority of them are more or less movable.

The influence of the infiltrating character of the wall of an abscess, as distinguished from the non-infiltrating cyst-wall, is seen in the much greater power of displacement of organs and tissues possessed by cysts. In the abdomen cysts of large size displace neighbouring parts enormously, but abscesses, by causing matting together of the parts around them, displace organs to a much lesser extent.

CHAPTER XX

DIAGNOSIS OF PULSATING SWELLINGS

The most important point in the diagnosis of a pulsating tumour is to determine whether the tumour is an aneurysm or not; and secondly, if an aneurysm, whether the whole tumour is aneurysmal. As a rule the diagnosis is easy, provided care is taken and reliance is not placed upon any single sign, but upon a due weighing of all the signs.

The tumours which pulsate may be thus enumerated:

- Aneurysm—fusiform, sacculated, cirsoid, false, arterio-venous.
- Pulsating tumour.
- Tumour or abscess situated over an aneurysm.
- Tumour or abscess situated over an artery or over the heart.
- Empyema.
- Encephalocele.
- Traumatic cephalhydrocele.

We shall first detail the examination that should be made, and then, putting together the facts thus obtained, mention the distinguishing features of each of these tumours.

1. Notice the **position** of the swelling in relation to the arteries of the part.

Aneurysms are only met with in or near the course of main arteries, tumours with communicated pulsation are only found over large arteries. Other pulsating tumours may occur in the course of, or quite away from, large arteries.

2. Examine the **pulsation** and determine the following points: i. Is the pulsation *expansile*, i.e. is the tumour enlarged in all directions by each beat of the heart, or is the impulse *heaving*—a mere lifting or displacement of the tumour? This is best determined by observing whether two fingers placed on opposite sides of the tumour are separated by each beat or are merely raised. An expansile pulsation is caused by blood being forced into the tumour, and shows that it is either an aneurysm or a very vascular tumour. A heaving pulsation indicates that the tumour is so close to an adjacent artery or the heart that it is lifted by it. Should an aneurysm become solidified without obliteration of the artery, the impulse will be heaving and not expansile.

ii. Is the pulsation *uniform* throughout the swelling? This is usually the case in aneurysm. If the pulsation is felt only along the course of the artery, it is communicated. If parts only of the tumour pulsate, it is probably a pulsating malignant growth.

iii. Can the pulsation be *abolished* by changes in the position of the tumour which do not affect the circulation through the part? If so, the pulsation is a communicated one.

3. **Compress the main artery of the part above the swelling,** and notice the effect upon the swelling of thus arresting the flow through the artery of the part. It will stop the pulsation, except in some cases of cirsoid aneurysm. If the swelling spontaneously shrinks, it is an aneurysm with free communication with the artery. **While the main artery is still compressed, apply a gentle pressure to the tumour and notice its effect.** If gentle pressure on the swelling does not cause it to

diminish in size, it indicates a pulsating growth, or a swelling with communicated pulsation not opening into a cavity, or an aneurysm nearly or wholly solidified. If the swelling yields to gentle pressure, it shows that it is partly fluid, and that the fluid can be passed into an artery or into some cavity, such as a vein, a joint, or a serous cavity, or a deep pouch of an abscess. Such a tumour may be an aneurysm, an arterio-venous aneurysm, an abscess or cyst, or an encephalocele. The amount of reducibility indicates the amount of fluid contents.

If when the compression of the artery is removed the tumour is filled out again by two or three heart-beats, it shows that arterial blood is distending a sac, and that the tumour is an aneurysm. If the pulsation at once returns uniformly over the whole swelling and without enlarging the tumour, it indicates either that the pulsation is communicated or that the swelling is a pulsating growth.

4. Examine carefully to determine whether there is any **mobility of the swelling apart from the neighbouring artery.** Arteries admit of a limited amount of lateral movement but of none in their length, and therefore, having relaxed as far as possible all the fasciæ and muscles of the region, the surgeon should try whether the swelling under consideration is movable in the line of the artery. When this mobility is present it is very strong evidence of the pulsation being communicated. As an example of the great diagnostic value of this sign may be mentioned the rise and fall of a thyroid swelling during deglutition, which absolutely distinguishes it from a carotid aneurysm. Some swellings with communicated impulse are quite immovable, e.g. abscesses over arteries; "pulsating tumours" are very often immovable because of their

growth from bone. Some abdominal tumours may be moved from over an artery, and so lose their pulsation.

5. **Attempt to reduce the swelling** without compression of the main artery above. This manipulation, like all the others, must be carried out with great gentleness and care. If successful it shows that the reduced part of the swelling is fluid and that it is not an aneurysm, and further that it communicates with a cavity such as the cranium or a joint. By this sign, then, we can diagnose a synovial cyst communicating with the knee-joint and having communicated pulsation from a popliteal aneurysm, or an encephalocele from a "pulsating tumour" of the cranium. Part of a pulsating swelling may be thus reducible in the case of two tumours of different nature blended into one swelling.

6. Examine for **bruit** and for **thrill.** If a *bruit* is heard over the swelling, determine—(*a*) Its time; if systolic, the swelling may be an aneurysm, or a growth compressing an artery, or a very vascular tumour; if both diastolic and systolic, it is an aneurysm. (*b*) Whether it is intensified by pressure; if it is, it is due to partial compression of an artery. (*c*) Whether it is heard over the whole tumour, or only along the course of the artery; the latter condition indicates communicated pulsation. (*d*) Whether it can be heard beyond the area of the swelling; if so, it follows that the tumour is an aneurysm.

A *thrill* is felt in some cases of aneurysm, but particularly in cases of direct communication between an artery and a vein. In aneurysm it is limited to the tumour, and its presence depends upon the relative size and conformation of the mouth of the sac, and possibly, too, upon the condition of the interior of the sac. In aneurysmal varix the thrill is often very intense, and is also characterized by its wide extent, being felt in some cases along the veins of a whole extremity. In certain conditions of the arterial wall, and possibly also of the circulating blood, a thrill can be produced by compression of an artery against a firm tumour or a bone; the thrill is then increased by gentle pressure.

7. Examine the **pulse** in the arteries beyond the swelling. If the pulse wave is delayed, smaller in size, and a sphygmogram shows loss of "percussion stroke," these signs would be strong evidence of an aneurysm. If the pulse is unaltered in any way, it shows either that the tumour is a very vascular pulsating growth, or that its pulsation is communicated only. Loss of pulse below a tumour may be caused by an aneurysm, by a ruptured aneurysm, by a ruptured artery, or by embolism; it cannot be due to compression of the main artery by the tumour, so long as that tumour itself pulsates.

8. Examine the **condition of the heart and arteries generally.** Aneurysm is in many cases associated with arterio-sclerosis and hypertrophy of the heart.

9. Notice the **outline** of the tumour, whether well or ill defined; also its shape and tension, and the state of the tissues over it, and of the parts distal to it. Tumours and aneurysms are well defined and, as a rule, tense; inflammatory swellings and leaking or ruptured arteries and aneurysms are always ill defined. Extravasated blood may reach and stain the skin; superficial hyperæmia and œdema are common over inflamed tissues; coldness and wasting of a limb, even paralysis, may be found beyond an aneurysm, and œdema, lividity,

and threatened or actual gangrene may supervene upon rupture of an artery or of an aneurysm.

It is necessary to insist that all manipulations of a pulsating tumour should be conducted with the utmost gentleness and care, and that when once the diagnosis of an aneurysm has been made no further manipulations of the part are justifiable; it is not intended, therefore, that all the above procedures are to be gone through in every case of pulsating swelling. The surgeon has to answer the question, Is the swelling an aneurysm? and it is only when that question cannot be answered in the affirmative that such varied and prolonged manipulations are justifiable to clear up the diagnosis.

It may be well to state here that an *aneurysm may lose its pulsation*—(*a*) from solidification of its contents, (*b*) from occlusion of the mouth of the sac by coagulum, (*c*) by compression of the artery above by the sac, or (*d*) by its rupture. The rupture of an aneurysm may take place slowly, the blood clotting in the tissues; or rapidly and even suddenly, the blood infiltrating the tissues far and wide, or escaping into a cavity.

10. **Pressure effects.**—Examine the parts distal to the tumour for signs of œdema and dilated veins, of paralysis of sensory or motor nerves. These signs are particularly associated with aneurysms because of the close proximity of veins and nerves to the arteries from which aneurysms spring, and also because the pressure exerted by an aneurysm is so very great. Another striking pressure effect of aneurysm is rapid absorption of bone, most commonly seen in the spine, sternum, or femur. The wasting of muscle in a limb beyond an aneurysm, apart from paralysis of motor nerves, is due to lessened blood supply.

We will now briefly describe the **diagnostic signs of individual pulsating swellings.**

1. If, in a person with signs of general arterial degeneration, an elongated pulsating swelling is found in the position of one of the large arteries, which tapers at each end into the artery, it is a **fusiform aneurysm.** Slow growth of the swelling and absence of pressure symptoms are more frequently met with in fusiform than in sacculated aneurysm.

2. A circumscribed globular or ovoid tumour over a large or medium-sized artery, immovable apart from this vessel, with expansile pulsation in every part, collapsing to some extent when the artery above is compressed, and then yielding to pressure, filling out again, when the compression is removed, with two or three strong bounding pulsations, with a well-marked bruit conducted along the artery, the pulse in the artery beyond the swelling being retarded, smaller and of less tension than in the corresponding vessel of the sound side, is a **sacculated aneurysm.** Should there be a history of an injury or of strain, of alcoholism, syphilis, or gout, or of a sense of something giving way at the seat of the swelling, and should the heart show signs of hypertrophy while the arteries give indications of general degenerative disease, this diagnosis will be confirmed. An aneurysm is not compressible if there is a great deposit of clot in its cavity, although even then there will be slight modification of tension produced by compression of the artery above. Bruit and thrill may occasionally both be absent.

If an aneurysmal tumour becomes more clearly defined, with a less superficial and a less clearly expansile pulsation, and it is less compressible and reducible, it indicates the *gradual obliteration* of its cavity by clot.

When the tumour is firm, incompressible, and exhibits a heaving, non-expansile pulse, it shows that the *aneurysm is entirely obliterated*, but the artery on which it is placed is still pervious. Such a tumour, if seen for the first time in this condition, would be distinguishable from an independent solid tumour over the vessel by its fixity to the artery. When all pulsation ceases in the firm contracting tumour, it shows that the *artery* from which it springs is also *obliterated*.

If the tumour is noticed to enlarge, and at the same time the pulsation has become more superficial and more distinctly expansile, the *aneurysm is enlarging*. But if the tumour is growing rapidly, and its outline has become less defined and its pulsation less distinct, there is a small rupture of the sac, and it is a *leaking aneurysm*. But if, either spontaneously or after some injury or strain, the tumour rapidly becomes greatly increased in size, with an entire loss of its clearly marked outline, with first great weakening and soon total loss of its pulsation, and loss of pulse in the arteries below, it has *ruptured*—it is a *diffused aneurysm*.

X-rays may be of help in the diagnosis of an aneurysm. Under the screen, especially in cases of intrathoracic aneurysm, pulsation may be seen before it can be detected by the hand, and a skiagram will show the outline of the whole tumour and so enable its size and relations to be fully appreciated.

3. An irregular compressible swelling, obviously formed of tortuous and sacculated tubes, with marked expansile pulsation and loud systolic bruit, is a **cirsoid aneurysm.** This affection is most common in the scalp and the hands, though it may occur in deeper situations, such as the orbit and iliac fossa. Sometimes congenital, it is more common before than

after 30 years of age, and it may follow an injury. As it grows it extends superficially, and does not exhibit a tendency to form a globular tumour. The skin covering the swelling is hotter than the surrounding skin; it may be thickened, but is often thinned, inflamed or ulcerated. The arteries which lead to the swelling are often dilated and tortuous.

4. If the vein or veins of a part are found dilated, with expansile pulsation, well-marked thrill, and a loud rasping or hissing continuous murmur, the murmur being increased in intensity at each cardiac systole, and conducted along the veins for some distance, it is an **aneurysmal varix.** If, in addition to these signs, there is a more or less distinct tumour at the spot where the murmur is most intense, fixed to, but distinct from, the artery and vein, compressible, with expansile pulsation, it is a **varicose aneurysm.** These diseases generally follow an injury, either a stab or a gunshot wound. As a rule an aneurysmal varix develops within a very short time, but a varicose aneurysm may not appear for months or even years. The bruit is not uncommonly so loud as to be audible to the patient, and sometimes even to bystanders. The name **arterio-venous aneurysm or aneurysm by anastomosis** is applied to both of these conditions.

5. If after an injury or strain an ill-defined swelling suddenly or rapidly develops over a large artery, with expansile pulsation, rough bruit, and thrill, gradually increasing tension and cutaneous ecchymosis, and there is abolition of the pulse and venous obstruction with œdema below the swelling, it is a **ruptured artery.** If the case is seen for the first time after rupture has occurred, the diagnosis between a ruptured artery and a ruptured aneurysm will rest upon

the history. If the patient had a tumour or noticed a "beating" sensation or neuralgic pain down the limb, or venous distension, and if the vessels are found atheromatous and the heart hypertrophied, it would point to the presence of an aneurysm. As regards the abolition of the pulse in the arteries below an aneurysm, it must be remembered that while this, when taken with other signs, is a most characteristic sign of a ruptured artery or diffused aneurysm, it must not be depended upon alone, for it may be caused by the gradual growth of an aneurysmal tumour compressing and then obliterating the mouth of an artery, or by plugging of the artery by a portion of clot displaced from the sac. When an artery is torn completely across, or an aneurysm ruptures by a large aperture, the tumour is devoid of pulsation.

6. If a tumour has an expansile pulsation which is felt all over the tumour, or is present in certain situations only, and if it neither collapses nor is compressible when the artery above is controlled, and the pulsation returns at once when the pressure upon the artery is removed, it is a "**pulsating tumour.**" If the tumour has been first noticed away from the site of a main vessel, or has shown pulsation only late in its history, if it be fixed to a bone and the bone can be traced over its base or surface for any distance, if there is expansion of the bone, egg-shell crackling, or spontaneous fracture of the bone, the diagnosis is rendered more certain. These tumours are often of irregular outline and of varying consistence at different places; a soft blowing murmur may be heard in them.

A similar tumour attached to the skull occurs in the condition of "thyroid malignancy," and is a carcinoma. The presence of a carcinoma in the thyroid gland confirms the diagnosis, although in some cases the gland appears to be the seat of a simple enlargement only, or even quite normal.

7. The diagnosis of abscess or other tumour associated with aneurysm is fraught with great difficulties. The presence of an abscess will have to be determined by the usual signs of that affection, the ill-defined swelling, fluctuation, redness, heat, severe pain, and pyrexia. The association of aneurysm with it may be suspected from the history of the case, and the suspicion becomes confirmed if a blowing bruit is detected; and if, in addition to that, it is found that the swelling collapses somewhat, and is compressible when the artery above is controlled, and then fills out again with successive thuds when the compression is removed, the diagnosis of **abscess over an aneurysm** becomes certain. If one part of a pulsating swelling is found to be more or less clearly marked off from the rest, and to have a heaving and not an expansile impulse, to be unyielding when the artery above is compressed, and to be movable apart from the rest of the swelling, a **solid tumour over an aneurysm** is to be recognized. Should a swelling with these general characters be found to fluctuate, and there are no signs of inflammation, the association of **cyst and aneurysm** must be diagnosed. If the fluctuating part of the tumour is reducible quite apart from controlling pressure upon the artery above, and after reduction fills out gradually, this diagnosis is confirmed.

8. If a tumour with a heaving impulse is found over a large artery, and it neither collapses nor is compressible when the artery above is controlled, and if the pulsation at once returns in its original force on removing the pressure upon the vessel, and especially if the pulsation is lessened or lost with

alteration in the position of the tumour, or if the tumour can be moved apart from the artery, it is a **solid tumour over an artery** with communicated pulsation. Both bruit and thrill are usually absent in such cases, as well as the characteristic alterations in the arterial pulse beyond the tumour; but each of these signs may be met with or may be produced by pressing the tumour more firmly against the vessel. Should the tumour fluctuate, and be incompressible and immovable, with an ill-defined outline, unaltered except in the one matter of pulsation by control of the artery on the cardiac side, and especially if there are signs of inflammation in the part (redness, heat, pain, fever), it is an **abscess over an artery,** with communicated pulsation. If, however, the tumour, with these general characters, is found to be compressible and reducible, whether the artery above is controlled or not, and it fills out again gradually and not *per saltum*, a **reducible tumour over an artery** is to be diagnosed. In the ham this will be a synovial cyst. A **cyst over an artery** not communicating with a joint or other cavity resembles an abscess, except that it is more defined in outline, is very chronic in its course, and is without signs of inflammation.

In no case where there is swelling over an artery is a diagnosis to be made until aneurysm has been excluded.

9. A fluctuating swelling on the left side of the chest, that pulsates synchronously with the heart, is fixed to the chest-wall, and slowly enlarges, and is accompanied by displacement of the heart to the right, dullness over the subjacent area of the thorax, fever, and dyspnœa, is a **pulsating empyema.**

10. A congenital sessile tumour fixed to the skull, fluctuating, and with more or less well-marked ex-

pansile pulsation, is an **encephalocele.** These tumours are most frequent over the middle of the occipital bone, then at the root of the nose, or at either fontanelle; but they may occur in connexion with the base of the skull, and project into the pharynx. They are more or less globular in shape, become more tense during strong expiratory efforts, and are partially reducible into the skull. Pulsation may be absent owing to the amount of fluid in the sac (meningo-encephalocele). These tumours are very generally, but not always, associated with hydrocephalus.

11. If after an injury to the vault of the skull in a young child a swelling forms which persists and remains soft and partially reducible, pulsates synchronously with the heart, and has an impulse on coughing or crying, it is a **traumatic cephalhydrocele.**

12. A similar swelling is met with after a decompression operation, if at the time of the operation the cause of the increased tension within the skull be not removed, but as a rule such a swelling steadily increases in size.

If after a gunshot wound of the skull the scalp heals soundly but there is a gap in the cranium which is not filled by new bone, a bulging of the brain through this gap results in a small swelling presenting the same physical characters. In the absence of intracranial inflammation, such a swelling does not increase in size.

CHAPTER XXI

GENERAL DIAGNOSIS OF ULCERS

The diagnosis of an ulcer includes the recognition of its *condition* and its *cause*. The determination of the former depends upon a careful observation of its *features*, whilst to recognize the latter necessitates in many cases, in addition, an examination of the general condition of the patient, a history of the progress of the sore, the detection of any concomitant affections, and possibly bacteriological and microscopical investigations. We shall describe first the features of ulcers, secondly the diagnosis of their conditions, and then, briefly, the diagnosis of each form of ulcer that may be met with.

1. **General features of ulcers.** i. **Base of the ulcer.**—Notice (*a*) whether it is *shallow* or *deep*, indicating a slight or more extensive loss of substance; (*b*) whether it is *smooth* and more or less *glistening*, i.e. inactive; (*c*) whether it is covered with slough, i.e. tissue in process of destruction by gangrene, or (*d*) with granulations, indicating a more or less perfect attempt at healing; (*e*) whether there is infiltration of the base, recognized by thickening of the underlying structures. Such infiltration may be accompanied by deep excavation of the ulcer or by the projection of large warty excrescences from its base.

The base of an ulcer may exhibit special characteristics, such as those which constitute it a *sinus* or a *fistula* (*see* Chap. XXII.), or it may be covered with the false membrane of *diphtheria*.

ii. **Edge of the ulcer.**—This may be *sloughy* and irregular when the process is still advancing, or *punched-out* when a slough has separated; or *rounded* and *thickened*, indicating a chronic stationary ulcer. An *infiltrated edge*, firm and swollen and continuous with an infiltrated base, demonstrates that the ulcer is secondary to a previous infiltration of the tissues, e.g. a granuloma or carcinoma. Further, the edge may be *undermined*, i.e. there is more widespread destruction of deep tissues than of the skin, or it may be *everted* as in ulcerating cancers. Or it may be obscured by a sprouting mass of granulations or new growth. Finally, in an epitheliating ulcer the edge is *shelving*, and careful observation reveals three concentric zones: the innermost narrow, smooth, and deep-red in colour, the middle of a pale-purplish hue, and the outermost milk-white and covered with thin epidermic scales. Note should be made of the shape of the ulcer, whether the edge is straight, irregular, or curvilinear—formed by the coalescence of adjacent circular ulcers.

iii. **Condition of the tissues surrounding the ulcer.**—These may be *quite healthy*, showing the limited character of the lesion, or *inflamed* or *eczematous*, and it must then be determined whether the ulcer preceded this condition or vice versa. The tissues may be *infiltrated* and *matted together*, or there may be great *overgrowth* of the surrounding *epidermis*, as in "perforating ulcer" of the sole. There may be definite *circumscribed infiltration*, due to the presence of a tumour, part of which has ulcerated. In some cases the surrounding skin is cold and livid; attention should then be directed to the vessels of the part—induration, tortuosity, or obstruction of arteries, varicosity or occlusion of veins; and to the nerves—altered sensation, abnormal condition of reflexes, motor paralysis, or local sweating.

iv. **The discharge.**—The amount of the discharge varies directly according to the activity of the ulcerative process and inversely to the rapidity of repair. It may be increased by admixture with urine, fæces, milk, saliva, bile, etc. In character it may be purulent, ichorous, sanious, or serous; it may deposit on the neighbouring skin or when dried a chalky sediment of sodium urate, indicating the gouty nature of the ulcer. Microscopically it may be found to contain distinctive cells, e.g. in epithelioma; or bacteriologically the presence of specific organisms may be shown, e.g. *B. tuberculosis*, *Actinomyces*, *Spironema pallidum*, etc. Auto-infectivity may be shown by the occurrence of secondary ulcers on surfaces exposed to the action of the discharge.

v. **Pain of the ulcer.**—The pain may be nil or it may be the intense, throbbing, burning pain of inflammation. Or the pain may radiate along the course of the nerve distributed to the ulcerated surface, or be limited to one or more exquisitely tender spots on the surface of the ulcer. In some cases pain is only excited by movement of the ulcer or by contact with its surface.

The examination of the ulcer and tissues immediately surrounding it must be followed by observation of the following additional facts which help in the diagnosis:

(1) **Position of the ulcer.**—The occurrence of ulcers in situations exposed to injury, such as the skin over the heel or the front of the ankle, suggests a traumatic origin; whilst ulcers found at parts most distant from the heart (the tips of the fingers and toes) are probably due to circulatory disturbance.

When found upon paralysed limbs the cause is most likely to be some trophic condition. Speaking generally, a wide distribution of ulcers indicates some blood-borne affection, whilst a local grouping may be the result of either constitutional or local causes.

Certain forms of ulceration are almost limited to definite regions of the body, e.g. lupus to the face and arms, rodent ulcer to the upper half of the face, varicose ulcers to the lower half of the leg, "soft sores" to or near the genitals, tuberculous ulcers to the neck or over bones and joints.

(2) **Number of ulcers.**—The greater the number of ulcers the more likely are they to be due to a constitutional cause; but a single ulcer may be syphilitic, and widespread ulceration may be due to a local cause, such as scabies. Caution must therefore be used in attaching importance to this factor.

(3) **Shape of the ulcer.**—Syphilitic ulcers are very commonly either circular and punched-out, or, by the coalescence of several circular units, take on a sinuous outline rarely seen in any other condition. Tuberculous ulcers are commonly oval in shape.

(4) **Mode of origin.**—Inquiries into the mode of origin may reveal a *purely traumatic* cause, or what may be termed a *partially traumatic* one—i.e. the original injury is unattended by destruction of tissue, and ulceration only follows as a result of local infection, possibly favoured by local malnutrition of the part or a general depressed state, such as is found after severe illness or in those suffering from diabetes, renal disease, or starvation. Occasionally an ulcer is seen to originate in a small black gangrenous patch of skin which is clearly due to a localized vascular lesion, such as thrombosis of small vessels. It is common for ulcers to follow a previous condition of induration or the appearance of papules,

nodules, or a definite tumour, e.g. in lupus, gumma, or epithelioma. Lastly, ulcers may result from the progress of inflammation, either spreading from the surface into the deeper tissues, as in eczematous ulceration, or from the deeper structures to the surface, as in the ulcers formed by suppurating or caseating lymphatic glands.

(5) **State of the glands which drain the affected area.**—If the glands into which the ulcerated area drains are enlarged, it is evidence of the infective nature of the ulcer, and the result of the infection of the gland is often quite characteristic. In pyogenic ulcer and "soft" chancre a single gland becomes acutely swollen, with the usual signs of periadenitis. With a syphilitic chancre several glands are found moderately enlarged, firm, not tender, and movable in the cellular tissue. In epithelioma the glands first become firmer than normal, then steadily enlarge and become fixed in their bed. The absence of glandular enlargement in rodent ulcer is very noteworthy.

(6) **Age.**—Traumatic ulcers may be met with at any age; excluding these, the ulcers most common in children and young persons are tuberculous sores and lupus, and ulcers from congenital syphilis; in adults, syphilitic ulcers predominate; in middle life and old age, "chronic" and "varicose" ulcers, gouty and malignant ulcers, including rodent ulcers, are most frequent. The influence of age is by no means absolute, even rodent ulcer having been met with under 20 years of age.

2. **Condition of an ulcer.**—Ulcers may be classified into three main groups, according to whether they show signs of *spreading*, of *healing*, or of being more or less *stationary*.

i. **Spreading ulcers.** — The characteristics of a spreading sore are an entire absence of granulations over the base, which is either uneven and spongy in appearance, or more or less completely covered with sloughs; an uneven, irregular, inflamed, or sloughing edge; and an inflamed or œdematous condition of the surrounding skin. There is free discharge of purulent or sanious fluid, and a history of progressive enlargement in one or in all directions.

ii. **Healing ulcers.** — The characters of an ulcer which is healing are a base covered with even florid granulations, an epitheliating edge of three concentric zones, an absence of inflammation in the surrounding tissues and of pain, and the discharge of a small amount of turbid serum. In the less satisfactory grades of healing the granulations are uneven, exuberant, easily bleeding, or pale, flabby, and œdematous, the edge may be thin and purplish, the surrounding tissues still inflamed, and the discharge frankly purulent. Such ulcers may be painful.

iii. **Stationary ulcers.** — Great variations are met with in chronic ulcers, but the features common to all are an absence of healthy granulations, a thickened, rounded, adherent edge, infiltration of the surrounding tissues, thickening and pigmentation of the skin in the neighbourhood, and a thin, watery, but foul discharge. Severe pain and tenderness may be present, especially in chronic ulcers of the anus and legs.

The various ulcers that are commonly met with in surgical practice are conveniently classified under the three following headings:

1. Ulcers due to injury or to pyogenic organisms, with or without predisposing circulatory or nervous disturbances.
2. Ulcers due to specific micro-organisms.
3. Malignant ulcers.

1. **Traumatic or pyogenic ulcers.**—The following ulcers belong to this group:

i. Traumatic ulcer.
ii. Varicose ulcer.
iii. Eczematous ulcer.
iv. Perforating or trophic ulcer.
v. Bedsore.
vi. Gouty ulcer.

i. An ulcer occurring in a healthy subject, and in healthy tissues, as the result of an injury, is a **traumatic** ulcer. Injury often enters into the production of other ulcers, especially the so-called "varicose" ulcers.

ii. A chronic ulcer situated on the lower half of the leg, or about either malleolus, with depressed base, smooth or covered with a few scattered, ill-formed granulations or a thin greenish or grey slough, with thickened adherent edge, firm, congested, tender and adherent surrounding skin, and with enlargement of the superficial veins of the limb, is a **varicose** ulcer. These ulcers usually originate in some trifling injury which leads to infection of the skin with pyogenic organisms, and are not directly dependent upon varicosity of the veins. They occur most often in women at and after middle life, and among the poorer classes. They cause varying degrees of pain.

iii. An ulcer situated in a diffused area of reddened swollen skin, with adherent scales or crusts of epidermis and dried discharge, is an **eczematous** ulcer. Such sores are often multiple. It is important to determine whether the eczema preceded the ulceration, for sometimes the discharge from an ulcer, or an improper mode of dressing, causes an eczematous condition of skin around an ulcer of different origin.

iv. A very chronic painless ulcer on the sole of the foot, surrounded by thick horny cuticle, deep, and leading down towards or to bone, is a **perforating** or **trophic** ulcer. Such ulcers are usually small, and may be multiple. They are found in connexion with diseases causing anæsthesia of the sole, such as locomotor ataxy, spina bifida, caries of the spine, neuritis from any cause, leprosy, and in congenital club-foot.

v. An ulcer occurring over the sacrum, scapulæ, or heels in a debilitated patient confined to bed, preceded by hyperæmia of the skin, and extending steadily and painlessly both in area and depth, the edge being irregular and thin, the base covered with slough and with an offensive discharge, is a **bedsore.**

vi. An ulcer occurring over a gouty deposit, small, shallow, and smooth, the discharge from which leaves a white chalky deposit on the surrounding skin, is a **gouty** ulcer. There will be the history and other evidences of gout to aid in the diagnosis.

2. **Ulcers due to specific micro-organisms.**—The ulcers included in this group are:

i. Syphilitic.
ii. Tuberculous.
iii. Soft chancre.
iv. Actinomycosis.

i. **Syphilitic ulcers.** — An ulcer, usually single, acute in its course, with well-marked induration of the base and edge, the ulceration being, perhaps, not more than a superficial abrasion, and accompanied by moderate enlargement of the neighbouring group of lymphatic glands, which are firm, but movable under the skin and over each other, is probably a **Hunterian chancre.** The diagnosis should not rest upon the above characters, but upon the detection in the discharge, or in a drop of fluid withdrawn by means of a hypodermic syringe from the sore, of the *Spironema pallidum*, the specific organism of syphilis. (For method, *see* p. 622.)

Round or oval ulcers in a cachectic patient, not very numerous but widely scattered, with purplish margin and steep sides, the soft base obscured by dried secretion in the form of a limpet-shell-shaped brown crust, are **secondary syphilitic ulcers** or **rupia.** A positive Wassermann reaction will confirm the diagnosis.

Tertiary syphilitic ulcers have many characteristic features, one or more of which may be present in any given case. They are as follows :—

(*a*) *Number.*—They are often, but not always, multiple.

(*b*) *Position.*—They may occur in any situation ; if on the leg they are not limited to the lower half, are more common on the outer than on the inner side, and are very frequent about the knee.

(*c*) *Shape.*—Circular or oval, or irregularly sinuous from the coalescence of adjacent sores. An ulcer healing at one edge and spreading at the other, or an annular sore, is very characteristic.

(*d*) *Character.*—A punched-out appearance ; or a base covered with a tough, yellowish-grey, "wet-washleather-like" slough ; or dark, conical, adherent crusts ; or a base covered with very thick and firm mottled grey and pink granulation tissue ; or phagedæna, are all characteristic. Syphilitic ulcers may assume all the characters of "chronic ulcers." The healthy condition of the surrounding tissues and the absence of pain are noteworthy features of the deep and perhaps chronic ulcers of the leg.

(*e*) *Origin.*—In an induration, or in a gummatous infiltration.

Wassermann's reaction is in the great majority of cases positive, and confirmation of the diagnosis should be sought in this test.

ii. **Tuberculous ulcers.**—If the ulcer is chronic and superficial, situated in a nodular eruption on the face, arm, or hand, which commenced during childhood or youth, has only very slowly broken down, and has left smooth and shining scars behind, it is **lupus.** By the chronicity of the growth lupus is distinguished from chancre and epithelioma; it differs from the ulcerating tubercles of syphilis in the greater softness and vascularity of the tubercles, its much slower and less destructive course, as well as by the different associated affections, and by a negative Wassermann reaction.

An ulcer with pink or livid undermined edge, with weak flabby granulations covering the base, and thin purulent discharge, occurring in a child or young person, is a **tuberculous ulcer.** These ulcers are most common over lymphatic glands in the neck or elsewhere, or over joints. They result from the bursting of a collection of tuberculous debris which first causes redness and thinning of the skin. At this stage the condition may be mistaken for a true abscess.

iii. **Soft chancre.**—Multiple ulcers, situated on the genitals, or adjacent parts of buttock or thigh, having shelving, fissured edges, a soft base covered with greenish sloughs, surrounded by a red areola and exuding a copious purulent secretion, the neighbouring glands rapidly becoming inflamed and tending to suppurate, are **soft sores** or chancroids.

iv. **Actinomycosis.**—An ulcerated surface occurring in a nodular thickening of the skin over the lower jaw or neck, from which sinuses lead inwards towards the buccal cavity, with a thin purulent or sanious discharge and no enlargement of the lymphatic glands, and a history of the ulceration being secondary to a swelling, is probably actinomycosis. The diagnosis is confirmed by finding in the discharge "sulphur-granules," which consist of mycelium of the ray fungus. These ulcers may also occur on the trunk.

3. **Malignant ulcers** include the following:
   - i. Rodent ulcer.
   - ii. Epithelioma.
   - iii. Ulcerating carcinoma and sarcoma.

i. A very chronic ulcer on the face of an elderly person, slowly destroying all the tissues, presenting a very narrow indurated edge and a smooth shallow base, showing no signs of healing, but steadily though very slowly progressing, without infection of lymphatic glands, is a **rodent** ulcer. (*See also* p. 257.)

ii. An ulcer occurring in a person at or past middle life, which commenced in a wart or fissure, steadily progressed, and has a firm everted edge and firm uneven base, covered with pink granulations with yellow specks, with enlargement of the neighbouring gland or glands which have become adherent to the surrounding tissues as they enlarged, is an **epithelioma.** These ulcers are most common on the lips, tongue, penis, scrotum, vulva, and anus, around old sinuses, in old scars, and on surfaces that have been "burnt" by X-rays. They are very rarely multiple. The age of the patient, the progressive character of the affection, the infiltrated edge and base, and the enlargement of the lymphatic glands are eminently characteristic. (*See also* p. 257.)

iii. An irregular ulcer occurring in an infiltrating tumour is a **malignant** ulcer. This differs much in its characters, varying with the structure of the tumour in which it forms ; at times it is fungating, at others deeply excavated. It may be ulceration of the primary tumour or of glands secondarily involved. The character of the tumour, whether carcinoma or sarcoma, is largely determined by the site of origin of the primary tumour. (*See* Chap. XVIII.)

The diagnosis of ulcers of the genital organs is given at p. 622.

CHAPTER XXII

DIAGNOSIS OF SINUS AND FISTULA

In surgery the name *sinus* is given to a "long, narrow, suppurating canal," and *fistula* to such a canal when it communicates with a mucous, synovial, or serous cavity. An unnatural direct communication between two adjacent mucous surfaces is also called a fistula.

The diagnosis of a sinus is established by the passage of a probe along it, but the size and character of its aperture, the induration of its wall, and the amount of discharge which flows from it, or the special means by which that discharge can be made to flow, are other signs by which a sinus can generally be recognized. A sinus being recognized, the surgeon must first decide whether it is a fistula, by noticing the character of the discharge, and also whether a probe passed along it enters a mucous, synovial, or serous cavity.

Fistula.—Salivary fistula, branchial fistula, urinary fistula, fæcal fistula, anal fistula, and urachal fistula are noticed in later chapters. *Recto-vesical fistula* is recognized by the passage of fæces and flatus with the urine, and sometimes by the escape of urine from the bowel. *Recto-vaginal* and *vesico-vaginal fistulæ* are diagnosed by the passage of fæces or urine from the vagina, and also by direct inspection of the part: where urine dribbles continually into the vagina the fistula opens into the bladder; where it only flows into the vagina during the act of micturition the fistula opens into the urethra beyond the internal sphincter. A direct communication between the mouth and nose (*oro-nasal fistula*), whether congenital, traumatic, or syphilitic, is rarely, if ever, called by this name. A *pleural fistula*, which is more commonly spoken of as a *fistulous empyema*, is known by the history, the abundant escape of pus, often the passage of air into and out of the cavity with respiration, and the extent to which a probe can be passed.

The surgeon, having diagnosed a **sinus**, must investigate it thoroughly, to ascertain if possible its cause. He should inquire into the history of the case, and examine the neighbouring bones and joints for any evidence of disease, and then with a probe, or with his finger, he should explore it thoroughly, searching for *foreign bodies*, such as sutures, ligatures, bullets, and pieces of clothing, and for *exposed bone;* he should also ascertain the direction, length, and extent of the sinus.

In cases of doubt or difficulty the sinus should be filled with Beck's paste (bismuth carbonate 1 part, glycerin 2 parts), injected under some pressure, and a skiagram of the part be taken; the track of the sinus and its relation to bones, joints, and serous cavities can thus be demonstrated.

Necrosis and **caries** are very common causes and accompaniments of sinus. In *necrosis* the exposed bone is felt to be firm, often smooth, and it gives a clear sound on being tapped. In *caries* the bone is felt to be soft and irregular, and it yields a grating sensation, and not a clear ringing sound when tapped; these distinctive characters are only observed in typical cases. If neither of these causes for the sinus is found, the surgeon must see whether the cavity *drains* efficiently, as retention of discharge is a very common cause of non-healing; in other cases he will find the sinus runs between muscles or other structures which are constantly being *moved* over each other, and rest, with fixation of the part, is the condition necessary to healing. Associated with any of the above causes of sinus, or alone, the surgeon may find that the sinus is the superficial part of a chronic inflammatory process due either to pyogenic cocci, tubercle bacillus, or actinomyces, and that these specific organisms can be isolated from the discharge or the granulations with which the track is lined. Persistence of a sinus may possibly be due to derangement of the general health, or to trophic influences.

CHAPTER XXIII

DIAGNOSIS OF GANGRENE

THE diagnosis in a case of gangrene consists in the recognition of (1) the fact of the death of a mass of tissue, (2) the variety of the gangrene, and (3) its cause.

1. **Gangrene is recognized** by several **signs** which are variously combined in different cases.

i. **Complete anæsthesia.**—This sign is invariably present in gangrene, but by itself it is not evidence of tissue death, as it may be caused by injury or disease of a sensory nerve. It must be also borne in mind that although dead tissue is quite insensible, its manipulation while it is in connexion with living tissues may cause pain. In applying this test of vitality, therefore, care must be taken to use only such means as shall act upon the particular tissue or part of the body under investigation.

ii. **Arrest of circulation** is another constant sign of gangrene. It is evidenced by absence of all arterial pulsation, by arrest of flow in the superficial veins, as proved by pressure on the cardiac side not causing them to become distended, by the very slow return of the blood to capillaries from which it has been expressed by pressure, and by the bloodlessness of an incision into such dead tissues. This arrest of circulation is one of the chief immediate causes of gangrene.

iii. **Fall of temperature** necessarily ensues upon arrest of circulation, and is one of the signs useful in determining the onset of gangrene. If no means is taken to heat it artificially, a gangrenous part falls to the temperature of the surrounding medium. Coldness is not of itself diagnostic of gangrene; some persons, who habitually have cold extremities, on exposure to cold may suffer from extreme coldness and numbness of the fingers or toes, which yet recover perfectly. In Raynaud's disease, too, the affected parts often become quite cold and yet recover.

iv. **Loss of function.**—Muscles lose all power of contraction, glands cease to secrete. In a dead foot no contraction of the intrinsic muscles can occur, but the toes may be moved by the long flexors and extensors, the vitality of whose contractile parts in the leg is unaffected. The skin of gangrenous parts is not bathed in sweat, and while the cuticle is preserved intact it is dry. Similarly in gangrenous wounds there is an absence of efforts at repair; a gangrenous flap does not exude coagulable lymph, nor cover itself with granulations.

v. **Change in colour.**—This varies. The part may at first be blanched and bloodless, or intensely congested; in the one case it becomes shrivelled, dry, and brown in colour, in the other black with patches of brown or green, and the formation of discoloured blebs containing bubbles of gas. The superficial vessels are usually first marked out by brownish-red branching streaks. The colour depends upon the amount of blood in the part, and its change upon the diffusion of the hæmatin in the tissues, and its subsequent decomposition. Sloughs of subcutaneous tissue are usually of an ash-grey or pale-yellow colour, as seen in carbuncle; a sloughing gumma is of the same hue.

vi. **Post-mortem changes.**—In some cases these consist in desiccation, all the dead tissues becoming dry and hard; more frequently they consist in decomposition, characterized by liquefaction of the tissues, separation of the cuticle, the formation of blebs, the evolution of gas in the tissues, giving rise to bubbles in the blebs and to a putrid odour; in the case of gangrene of the lung the putrid odour of the breath is of great diagnostic value.

vii. **Spontaneous separation from the living tissues** by a line of ulceration is a later and absolutely certain sign of the death of the separated portion. Similar separation of living tissues never occurs. Small areas of dead tissue when aseptic may be removed by a process of absorption, with a gradual replacement of the slough by living tissue.

2. **Two varieties of gangrene** have been generally recognized, called *dry* and *moist*, and great stress has been laid upon the distinctions between them. There are many cases, however, in which their distinctive features are not present, and these are spoken of as *mixed*. The variations depend entirely upon the relative proportions of fluid in the dead tissues.

i. If the dead tissues become shrivelled, hard, dry, of a dark brown or black colour, with little or no odour, the case is spoken of as one of **mummification** or **dry gangrene.**

ii. If, on the other hand, the dead parts are sodden, mottled grey, black, or green in colour, with desquamation of the cuticle, and the formation of blebs containing brown-red fluid and gas, and if there is evolution of gas in the tissues (giving rise to emphysematous crackling or to bubbles along the line of the superficial vessels), and a dirty ichorous fluid exudes from the exposed cutis or from any wounded surface, while the whole part has a penetrating putrid odour, it is a case of **moist gangrene.**

iii. If in one part of the gangrenous mass the tissues are mummified, and at another they are moist and decomposing, or if they are neither mummified nor undergoing the rapid decomposition characteristic of cases of well-marked moist gangrene, the case should be spoken of as one of **mixed gangrene.**

Cases of gangrene may also be divided into **primary** and **secondary.** In the former there is direct and more or less immediate death of tissues, the preliminary symptoms being only those indicating a lessened vitality of the part, coldness, numbness, sense of weight, etc.; in the latter case the death of the tissues is preceded by acute inflammation with its usual phenomena, and the gangrene is caused by the intensity of the inflammation.

3. **Causes of gangrene.**—Gangrene may result from one or more of several morbid processes. The following are the most frequent and the best ascertained causes of gangrene:

i. Injury.
ii. Inflammation.
iii. Arrest of the circulation.
iv. Trophic lesions.

i. **Injury** may lead to gangrene directly or indirectly.

Directly, (*a*) by the destructive action of intense cold, heat, or caustics; (*b*) by destroying the vitality of a part by separating it from its vascular supply, as by accidental or surgical reflection of bloodless flaps, by compression sufficient to arrest the circulation, or by severe crushing of the tissues.

Indirectly, (*a*) by arrest of the circulation through main vessels producing gangrene of parts beyond, e.g. ligature, contusion, or wound of vessel; (*b*) by infection, inflammation, and arrest of the circulation.

ii. **Inflammation,** when intense, may induce gangrene by thrombosis or by strangulation of the vessels of a part, aided by the lethal influence of the toxins of pathogenic organisms upon living tissues. Examples are afforded by acute osteo-myelitis, cellulitis, furuncle, carbuncle, and gas gangrene.

iii. **Arrest of circulation,** however produced, causes the death of a part. As a primary cause of gangrene it is seen in arterial or venous thrombosis and embolism, strangulation of parts, Raynaud's disease, sloughing gumma, and possibly also in gangrene from ergot poisoning. It is a late factor in all other cases of gangrene.

iv. **Trophic lesions** may possibly be a direct cause of gangrene, but more often they predispose to gangrene by diminishing the resistance of the tissues to other lethal influences. Examples of trophic gangrene are afforded by the rapid sloughing that occurs in some cases of paraplegia and hemiplegia, by gangrene in syringo-myelia, in spina bifida occulta, and in locomotor ataxia, and by some cases of diabetic gangrene.

To arrive at a diagnosis of the *cause* of a case of gangrene, the surgeon should attend to the following points:

1. The *variety* of the gangrene, whether "dry" or "moist."

2. The *condition preceding* and leading up to the gangrene, as shown by the state of the *parts adjacent* to the gangrenous area. These may be blanched and cold, with feeble arterial circulation, or congested and œdematous, or acutely inflamed.

3. The *extent* of the gangrene, and especially whether it has spread beyond the part originally affected.

4. The condition of the *main vessels* of the part,

and of the body generally, especially evidence of sclerosis, embolism, and thrombosis.

5. The state of the *nerves*, especially signs of anæsthesia, of loss of reflexes, and of wasting.

6. The *general condition* of the patient, particularly his age and occupation, the state of his heart and of the circulation generally, the presence of albumin or sugar in the urine, and evidences of septic intoxication.

7. A history of *injury*, its nature and severity, and its relation to the occurrence and position of the gangrene, both as to time and as to the seat of the injury.

8. In some cases an examination of serum from the part will show the presence of *specific bacteria*, e.g. those of anthrax or of gas gangrene.

A study of these facts will usually make the cause of a case of gangrene evident, and, at any rate, the surgeon can place it in one of the three following categories: *traumatic, infective, spontaneous or symptomatic.*

1. **Traumatic gangrene** is characterized by the time of its occurrence and the extent of tissue affected. It comes on quickly or immediately after a severe injury, and is limited in area to the injured parts or to those on the distal side of the seat of injury. Examples are seen in the sloughing of contused or lacerated wounds, in gangrene of imperfectly nourished or too tightly sutured flaps, in the death of crushed limbs, in frostbite or burns, or injuries with caustics, in gangrene from tightly applied bandages and splints, or from bedsores, and in gangrene from the rupture or the ligature of a main artery—in this case the parts beyond the actual seat of the injury die.

2. **Infective gangrene** follows an injury, but this may be as insignificant as a prick or scratch.

and in any case the gangrene has marked characteristics: it spreads rapidly; it is not limited to the injured parts, or the part on the distal side of the injury; it is attended with grave constitutional disturbance; it is always pronouncedly "moist."

Of infective gangrene we can distinguish several varieties:

i. Where, after an injury, the limb becomes cold, numb, and swollen, and then quickly changes to a green or leaden hue, with all the evidences of total death of the part, and this condition rapidly spreads up to tissues not immediately affected by the injury, while there is an entire absence of all inflammatory phenomena preceding the gangrene, the case is one of **spreading traumatic gangrene,** from venous thrombosis. It is distinguished from traumatic gangrene due to direct injury of blood-vessels by its not coming on immediately after the injury, and by its rapidly spreading up along the limb towards the trunk to an extent quite independent of the original lesion. This form of gangrene is especially liable to occur in patients with a feeble circulation, either from debility or from hæmorrhage. It has not been actually proved to be due to "infection" in all cases, and the extensive thrombosis has been attributed to a slow, enfeebled venous circulation. It is more probable that organisms are the cause of the thrombosis in these cases.

ii. If after an injury, which may be quite trivial, there is rapid swelling of the part, which quickly spreads up towards the trunk, with redness, severe pain, and heat, together with marked constitutional disturbance, which is often ushered in by a rigor and characterized by high fever, rapid pulse, and marked general depression; and if this intense local inflammation is quickly succeeded by "moist" gangrene of the part, the disease is **acute septic gangrene.** The gangrene may spread up towards the trunk with fearful rapidity, the constitutional symptoms assuming still more of the "typhoid" type. A bacteriological examination of fluid from the gangrenous tissues reveals one or more varieties of pyogenic organisms.

When a wound is followed by grave constitutional disturbance, fever, rapid pulse, vomiting, and pain, and there is rapidly increasing resonant or even crepitant swelling of the limb with a characteristic odour and an orange-coloured discharge, **gas gangrene** has supervened. From such wounds *Bacillus Welchii*, *Vibrion septique*, or *Bacillus œdematiens*, can be isolated. (*See* p. 27.)

Patients with diabetes mellitus are more liable to extensive suppuration and gangrene from infection of a wound than are the healthy. In every case of gangrene the urine should be carefully examined for sugar; and if sugar is present, such a case is to be regarded as **septic diabetic gangrene.** There are two other forms of diabetic gangrene (pp. 310, 312.)

iii. **Hospital gangrene** is now very rare. It is very contagious and easily spreads from patient to patient. It occurs either in the *acute form*, characterized by severe constitutional disturbance and a swollen sloughing condition of the wound edges; or in the *chronic form*, in which, without such marked constitutional disturbance, the wound breaks down, enlarges, and slowly sloughs.

3. **Spontaneous gangrene** is recognized by (1) well-marked prodromata; (2) slow progress; and (3) the imperfect vitality of the neighbouring parts. Injury often plays some part in its production, but the injury is generally too trivial to cause the death

of the tissues directly, and there is an absence of the grave constitutional signs of infective gangrene.

Several varieties of spontaneous gangrene can be distinguished.

i. If a patient is suddenly attacked with severe pain in a limb (most often the leg), and the painful part is found cold, anæsthetic, slightly livid, with no pulsation in the arteries, and it then undergoes the changes characteristic of "dry" or "mixed" gangrene, it is a case of **gangrene from arterial thrombosis or embolism.** This variety is met with during convalescence from acute illness, especially typhoid fever, and in the subjects of heart disease. In cause, symptoms, and course it resembles gangrene following the ligature or rupture of a main artery. Constitutional symptoms do not come on until the line of separation has formed. Affecting quite small areas of tissue, it is sometimes seen as the starting-point of a chronic ulcer of the leg.

ii. If in an old person with tortuous rigid arteries, a weak heart, and a feeble circulation (shown by coldness of extremities, a dry scaly condition of the skin, and sometimes by œdema) a patch of gangrene appears on the toes, foot, or leg, or on the fingers, either spontaneously or subsequently to some very trivial injury, and is then not limited to the exact seat of the injury, it is **senile gangrene.** It is characteristic of this form of gangrene that all the changes associated with it progress very slowly, that the gangrene spreads or recurs, and that the ulcers left on the separation of the slough heal very slowly, or entirely fail to heal.

Diabetes often induces atheroma, and so may lead on to gangrene like senile gangrene. This is a second variety of *diabetic gangrene.* (*See* p. 309.)

iii. When the gangrene comes on in a limb which has been for some time previously the seat of very painful ischæmia—being cold, blue, mottled, a little œdematous, heavy, and benumbed—and the main arteries for some distance above the gangrenous area are found very firm, and either pulseless or nearly so, it is due to **obliterative arteritis.** This disease is more common in the lower limbs than the upper, in men than in women, and in those about middle life. It is distinguished from atheroma by being a local arterial disease and not generalized. The ischæmia it causes is usually intensely painful; it is always made worse by exposure and by cold, and is relieved by warmth. The arterial disease may exist for months or years before gangrene occurs.

iv. Gangrene occurring spontaneously in the hands or the feet, and occasionally in other parts, in patients who are subject to intermittent attacks of local ischæmia characterized by lividity, coldness, and a certain amount of pain of cramp-like character giving rise, in the legs, to the phenomenon of intermittent claudication, lasting from a few minutes to hours, or even longer, and sometimes accompanied or associated with attacks of angioneurotic œdema or of intermittent hæmaturia, is the **gangrene of Raynaud's disease.** This disease is met with in children and young persons as well as in adults, and the attacks occur most frequently in the winter months of the year. The distinct intermission of the attacks of local ischæmia and their frequent repetition are very characteristic signs of this disease.

v. Gangrene due to ergot-poisoning occurs only in persons living upon bread made from rye infected with the ergot fungus, and has never been known to follow the therapeutic use of the drug. The gangrene takes the dry form, and affects the fingers and toes, and also the tip of the nose and lobules of the ears.

vi. If gangrene develops with little or no pain, and without the usual signs of acute destructive inflammation, examine carefully for evidences of nerve disorder, such as anæsthesia, loss of reflexes, loss of muscular sense, other changes in local nutrition, and for paralysis. If such phenomena are present the case may be regarded as a form of **trophic gangrene.** This is met with under the following conditions:—

(*a*) As very rapid gangrene of parts exposed to pressure, friction, or other irritation, in some cases of *paraplegia* and *hemiplegia*, to be distinguished from ordinary bedsores by the extent and rapidity of the gangrenous process and the impossibility of preventing it by the greatest care in nursing.

(*b*) Gangrene of the toes and sole of the foot in patients with *locomotor ataxy* or *spina bifida.*

(*c*) Gangrene of the fingers or hand in patients with *syringo-myelia.*

(*d*) Gangrene of the toes and feet in patients with *diabetes*; this is the third form of diabetic gangrene, distinguished from the other two (*see* pp. 309, 310) by the painless course of the malady, by other signs of peripheral neuritis, and by the absence either of marked atheroma or of severe local inflammation.

CHAPTER XXIV

DIAGNOSIS OF SWELLINGS IN CONNEXION WITH BONES

How to determine whether a swelling is connected with the adjacent bone has already been discussed in Chap. XVII., and the difficulty of so doing has been pointed out. In some few cases the doubt can only be cleared up by making a careful exploratory incision, but the use of X-rays has greatly lessened the number of such cases. In this chapter it is proposed to discuss how best to arrive at the diagnosis of the nature of a swelling that has already been found to be fixed to, and immovable apart from, bone. The diagnosis of special tumours of particular regions, such as spina bifida and tumours of the jaws or skull, is discussed in the chapters on regional diagnosis.

1. Ascertain the **history** of the swelling. First, whether it is traumatic or spontaneous, then whether it appeared suddenly or developed more slowly, and finally whether it has continuously enlarged, remained stationary, or receded.

Traumatic swellings may be dislocations, fractures, hæmorrhagic, inflammatory, or neoplastic. An injury may be the starting-point of a tumour growth, or a tumour may only become apparent when some trivial injury has snapped the thin shell of surrounding bone, as in cases of central sarcoma of the shaft of a bone. Where a history of injury is given, care must be taken to ascertain whether there were any symptoms previous to the injury, such as local pain, and whether the injury is a sufficient explanation in itself of the subsequent course of events.

Spontaneous swellings are inflammatory, neoplastic, or diathetic. The acute specific fevers, especially enteric, are liable to be followed by inflammatory swellings of the periosteum. Swellings that *appear suddenly* are the direct results of injury—dislocation, fracture, effusion of blood. Swellings that *develop acutely* are usually inflammatory; a few are due to hæmorrhage, e.g. in scurvy-rickets. *Chronic* swellings may be the secondary results of injury, such as the thickening round a badly-set fracture, inflammatory, neoplastic, or diathetic. Swellings that *progressively enlarge* may be inflammatory or neoplastic; very rapid steady growth is a sign of inflammation, while steady enlargement over a long period and to a great size is a frequent and very characteristic feature of new growths. *Stationary* swellings may be the result of injuries, of chronic inflammation, or of some forms of benign tumour. *Receding* swellings are always either the result of injury, e.g. callus, or inflammatory, e.g. a node.

2. **Examine the tumour** with the hand and notice the following points:

i. The *part* and the *extent* of the bone involved: whether the diaphysis, the epiphysis, the junction between the two, the articular surface, or the entire bone.

ii. The *number* of the swellings: whether on one or on several bones.

iii. The *outline* of the tumour: whether well or ill defined, whether globular, lobed, pedunculated, ensheathing, or a mere general enlargement of the bone.

iv. The *consistence* of the swelling: hard, firm, or soft, yielding under the pressure of the fingers with a cracking sensation (egg-shell crackling); uniform, or variable at different parts.

v. The presence of *pulsation* in any part of the swelling, or of *mobility* in the bone at the site of the swelling.

vi. The presence of local heat, tenderness or pain, or of œdema or redness—signs of *local inflammation.*

vii. The presence of a *sinus* leading to the bone: with a probe a *sequestrum* may be struck.

viii. The range, the smoothness, and the pain, if any, of the movement in the *neighbouring joints.*

3. **Examine a skiagram** of the part and notice the following points:

i. **The bone.**—(*a*) Whether the line of the bone is continuous or interrupted, or its articular end is displaced.

(*b*) Whether the bone is rarefied or condensed, whether its medullary canal is expanded, narrowed, or wholly ossified.

(*c*) Whether the bone is bent or otherwise deformed.

(*d*) Whether the shadow of the bone is uniform, or at one or more places is denser from necrosis. A metal probe in a sinus will show the relation of the sinus to the bone or sequestrum.

ii. **The tumour.**—(*a*) Whether the swelling is on the outside of the bone or within it.

(*b*) Its exact relationship to the diaphysis, epiphysis, and articular surface.

(*c*) Whether it is pedunculated or sessile, well circumscribed or infiltrating.

(*d*) Its opacity or translucency; the distribution and arrangement of opaquer parts.

4. **Investigate the general condition** of the patient, looking especially for evidence of rickets, syphilis, tubercle, anæmia, and fever. In some cases a blood-count will be helpful. The evidence of a general diathetic state is only of value in the diagnosis when the local findings point in the same direction, for a patient may suffer from syphilis or rickets and also from sarcoma.

The facts thus ascertained are of value in the diagnosis as follows:

1. **Position of the lesion.**—Acute and chronic inflammation and periosteal sarcoma attack diaphyses; exostoses start at the line of junction of diaphysis and epiphysis, but as the bone grows in length an exostosis becomes farther removed from the epiphysis. Rachitic swellings are found at the union of diaphysis and epiphysis, or of rib and cartilage. Epiphyses may be attacked by tuberculosis, coccal infection, and myeloma, and the articular end may become the seat of osteo-arthritic and gouty swellings. The periosteum is especially attacked by various inflammations and by sarcoma. The medulla may be the seat of acute or chronic coccal invasion, of tuberculosis, of osteitis fibrosa or cyst, of myeloma, and of carcinoma. The compact bone may be the seat of rachitic bending, of osteomalacia, of Paget's disease (osteitis deformans), or of necrosis.

2. **Changes produced in the bone.**—i. *Rarefaction* of bone may be caused by tuberculosis, osteo-arthritis, osteo-myelitis, osteitis fibrosa, in the separation of a sequestrum, and by metastatic carcinoma.

ii. *Condensation* of bone may be caused by the repair of inflammation, in osteitis deformans, and around a tuberculous, syphilitic, or suppurative focus.

iii. *Expansion* of bone is caused by central sarcoma, carcinoma, or myeloma, by osteitis fibrosa, by mollities ossium (osteomalacia), by some cases of tuberculosis, particularly of the shaft of a bone, and by hydatid disease.

iv. *Erosion* of the surface of a bone is caused by periosteal sarcoma, and by epithelioma or other form of carcinoma extending down to a bone.

v. *Spontaneous fracture* in a bone tumour may be caused by either central or periosteal sarcoma, by secondary carcinoma, by osteitis fibrosa, or by hydatid disease.

vi. *Softening* of a bone is met with in swellings due to rickets and to mollities ossium.

3. **Physical characters of the swelling.** i. The *shape.*—An ill-defined edge which gradually fades off into the healthy bone is characteristic of inflammatory swellings; an abrupt outline is especially found in new growths of all kinds. A growth ensheathing a bone and spreading along its surface is generally a periosteal sarcoma; a globular outline is seen especially in myeloma, cysts, and ivory osteomata; a pedunculated growth attached to a diaphysis and not in a tendon or muscle is an exostosis, while a similar bony growth in a tendon or muscle is due to myositis ossificans.

ii. *Consistence.*—Bony hardness may be caused by ossification of the swelling, or by a lesion within a bone and expanding it. Some sarcomata of bone are so soft, and even fluid, as to give a sense of fluctuation.

iii. *Pulsation* of a swelling of bone is due to extreme vascularity, and is seen only in sarcoma.

iv. *Opacity.*—Bone is recognized by its opacity to X-rays; the density of the bone, and the arrangement of the bony lamellæ in cancellous bone, can be identified in a good skiagram. A tumour may thus be recognized as wholly bony or partly ossified, as formed of dense bone or of cancellous bone, as a condensation of softer bone, a thickening of bone, or an outgrowth of bone; and great aid to exact diagnosis is thus obtained.

4. **Conditions of the overlying tissues.**—Hyperæmia, local heat, œdema, and tenderness are evidences of inflammation. A glossy stretched skin with enlargement of the subcutaneous veins is a sign of actively growing and very vascular tumours.

If the swelling is acute it is one of the following:

Dislocation.	Periostitis.
Fracture.	Osteo-myelitis.
Hæmatoma.	Deep abscess.

For the diagnosis of dislocation and fracture, *see* Chapters XV., XVI.

If the swelling fluctuates and is either present at birth or follows immediately upon an injury, it is a **hæmatoma.**

But if the swelling has developed independently of injury, or has quickly but not immediately followed it, and there are the local signs of inflammation, with high temperature, quick pulse, and other evidence of fever, it is **acute periostitis.** Of this there are two forms, *circumscribed* and *diffuse.*

Circumscribed acute periostitis is generally due to an injury, sometimes to syphilis, or to enteric fever, and the history will determine this point. It is most common in the tibia. Examine the part carefully for fluctuation, which will indicate a *periosteal abscess.*

Fig. 1.—Osteo-myelitis with sequestrum (p. 319).

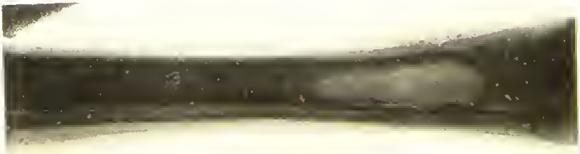


Fig. 2.—Chronic abscess of bone (p. 323).
Observe the periosteal bony thickening.

PLATE IV.

An acute swelling starting in the growing end of a bone and rapidly extending along its shaft, accompanied by local signs of inflammation, is caused by an infection of the part with virulent pyogenic bacteria, and is termed *acute necrosis of children, acute diffuse periostitis*, or *acute osteo-myelitis.* (Plate IV., Fig. 1.) The skin over the bone may not be reddened; there is œdema, and deep fluctuation can soon be felt. The constitutional symptoms vary in severity; as a rule the temperature is high, and all the signs of fever are marked; rigors or convulsions, profuse sweatings, delirium, and even coma may be met with. If the disease has not been arrested by treatment, it may present an enormous abscess surrounding the entire diaphysis of the bone, or sinuses leading down to a sequestrum, and there may be secondary abscesses and the other signs of *pyœmia.* As this disease starts near a joint, it is liable to be at first mistaken for rheumatism; this disastrous mistake can be avoided by noticing that the pain and tenderness are in the diaphysis, that the swelling extends rapidly along the diaphysis, that the constitutional symptoms are very severe, and that only one joint appears to be affected. The existence of **osteo-myelitis** in addition to the periostitis can be sometimes shown in a good skiagram, and can also be diagnosed when the constitutional signs are not relieved by free incisions into, and thorough cleansing of, the periosteal abscesses, and can be demonstrated by the evacuation of pus from the medullary cavity. This disease attacks growing bones; it therefore occurs in children and adolescents. It very occasionally starts at a distance from the end of the diaphysis in the completed bones of adults. It may occur in a less intense form than that described above.

A **deep abscess** unconnected with bone would be indistinguishable from the above except by finding, when opened, that the bone was nowhere exposed.

Chronic swellings of bone are as follows:

Hypertrophy.
Rickets.
Scurvy-rickets.
Syphilis.
Badly-united fracture.
Periostitis.
Abscess.
Osteitis deformans.
Necrosis and caries.
Tumour.
Myositis ossificans.
Osteitis fibrosa.
Hydatid cyst.

Occasionally, without any symptom of disease, the bones of one limb, or of one side of the body, are found larger than their fellows, and are spoken of as **hypertrophied.** The name is also given to the elongation which sometimes ensues upon inflammation of a growing bone, and to the thickening resulting from chronic inflammation. Strictly speaking, the name hypertrophy should only be applied when the increased size of the bone is due to its increased function, as, for example, where a fibula enlarges to take on the function of the tibia rendered useless by injury or disease.

If multiple symmetrical swellings occur in a child at the ends of the ribs, and over the junction of the epiphyses and diaphyses of the long bones, especially at the lower end of the radius and tibia, and if with these there are bending of bone, due to its softness, and delayed ossification, the diagnosis of **rickets** may be made. In many cases of rickets there are other well-marked signs, such as profuse sweating, especially about the head, with falling off of the hair, late dentition with early decay of the teeth, flabbiness of the muscles, emaciation, "pigeonbreast," "pot-belly," enlargement of the liver and spleen, vomiting, diarrhœa, and general tenderness of the surface.

If, in a young child, the shaft of one or more of the long bones is found to be enlarged, very tender —so tender that the child does not move the limb, and screams when it is moved or touched—and there is marked anæmia, the condition is **scurvy-rickets.** The gums will be found swollen, with petechial hæmorrhages into them. This disease most often attacks the bones of the lower limb. It occurs in those brought up on artificial foods, is frequently associated, therefore, with rickets, and whilst commoner in the first twelve months, may arise in children of a few years of age.

If the swelling occurs in the humerus, or tibia, of an infant or young child, is most marked over the epiphysial line, and gradually subsides up the shaft, especially if there is mobility of the epiphysis on the diaphysis, with soft or grating crepitus or suppuration, it is **syphilitic disease** of the bone. Other signs of inherited syphilis should be sought for. The disease may attack many bones, but in the limbs it is generally not symmetrical.

If the swelling is at the site of an old fracture, is stationary, hard, and painless, it may be recognized as deformity due to **union of the fracture in a bad position.** The exact details will be seen in a good skiagram. In fractures where there has been much comminution of the bone, or laceration of the soft parts, the mass of callus effused is but slowly absorbed, and signs of it may be found for many months as a firm, painless swelling round the bone. There are certain very rare cases in which the callus about a fracture steadily enlarges for some time, and very closely simulates a sarcoma.

A slowly formed swelling of a bone which gradually fades off into healthy bone, and is tender and painful, is due to inflammation of the periosteum—**periostitis.** This may be limited in area—circumscribed; or extend along a whole diaphysis—diffuse. It is often associated with inflammatory changes in the bone beneath and in the medulla—*osteo-myelitis.* A circumscribed periostitis is called a *node;* when caused by plastic ossifying periostitis it is known as a *hard node;* when the inflammatory effusion has softened into an abscess it is a *soft node.* Chronic inflammations of bone are most often due to tubercle and syphilis, but may be caused by enteric fever or by inflammation of a neighbouring soft structure.

When the thickening of the bone is beneath a long-standing ulcer or the scar of one, it may be attributed to the extension of inflammation from the ulcer to the periosteum.

When a limited swelling of the bone softens into an abscess, the pus should be examined for the *Bacillus typhosus.* Enteric periostitis and osteitis may follow the acute enteric fever after a long interval, even of years; it often attacks the ribs as well as the long bones of the extremities, and runs a slow course.

When the swelling of the bone is limited in area, but involves the entire circumference of a long bone, runs a slow and almost painless course, and after a time an abscess appears, it is *tuberculous.* In the early stage the bone is rarefied, but later it is condensed at the periphery. The patient is usually a child or youth, of delicate appearance, and he may bear other signs of tuberculosis. If the abscess is opened or has burst and formed a sinus, it is found that the sinus leads into a cavity in the bone, in which a sequestrum or soft carious bone may be felt. This disease is most often met with in the ends of long bones, in the metacarpus, tarsus, and phalanges, but it occurs also in the shafts of long bones. It is the common cause of *caries.*

Multiple, painful, tender swellings of subcutaneous bones with a tendency to recurrence are easily recognized as *syphilitic* owing to their association with other signs of syphilis. A slowly formed diffuse bony enlargement of the shaft of a long bone, very hard and heavy, is syphilitic ; the disease affects all the parts of the bone—periosteum, compact bone, and marrow—and ends in ossification. Occasionally, *gummata* form in bone and break down as in other parts, with or without the formation of definite sequestra ; the common bones to be thus affected are the vault of the skull, clavicle, and long bones of the limbs. Unlike other late syphilitic lesions, both these forms of syphilitic disease of bone may be accompanied by pain.

If there is a slight localized swelling of a long bone, which is the seat of constant and long-continued aching pain, especially at night, with marked tenderness to pressure or to a smart tap just at one spot, and if, further, the skiagram shows a clear area of bone with condensed bone around it, and some subperiosteal new-bone formation‘ there is an **abscess** in the bone. (Plate IV., Fig. 2.)

A very chronic enlargement of a bone in a patient past middle life is probably **osteitis deformans.** If the bone is increased in length as well as in circumference, and becomes abnormally curved, and the skiagram shows that the medullary cavity is diminished or absent, this diagnosis is confirmed. The disease, known also as *Paget's disease of bone,* affects many bones (skull, spine, clavicle, humerus, femur, tibia, etc.), and is attended with “ rheumatic ” pains. The disease may remain confined to one bone for months or years.

If the enlargement of the bone is attended with suppuration, and on opening the abscess, or on probing the sinus left by such abscess, hard, smooth, bare bone is felt, **necrosis** has occurred. A sequestrum is shown in a skiagram as a shadow denser than normal bone.

Inflammatory molecular disintegration or rarefaction of bone is often spoken of as **caries or ulceration of bone.** In the spine it is recognized by the occurrence of angular curvature, elsewhere by the existence of a cavity where none should be; fine granules of dying bone at the deep end of a sinus may often be felt. The rarefaction of the bone and its exact extent are best learnt from a good skiagram.

A slowly growing or stationary tumour, noticed first in early life, hard in consistence, opaque to X-rays, and attached to the diaphysis at or near an epiphysis, is an **exostosis.** Such a tumour is usually pedunculated, but may be sessile. It may be single or multiple, rounded or lobulated. It may have a bursa developed over it. Exostosis commences as a cartilaginous outgrowth, and so long as the growth continues a layer of cartilage will be found over the bone, but when the bone is completed the whole exostosis ossifies and growth ceases. In rare cases the tumour continues to grow after the ossification of the affected bone is completed; such tumours have much cartilage in their composition and are liable to become sarcomatous. Exostoses are most often met with at the lower end of the humerus and femur, and at the upper end of the tibia, under the nail of the great toe, and on the skull. Starting originally at the epiphysial line, they may by the growth of

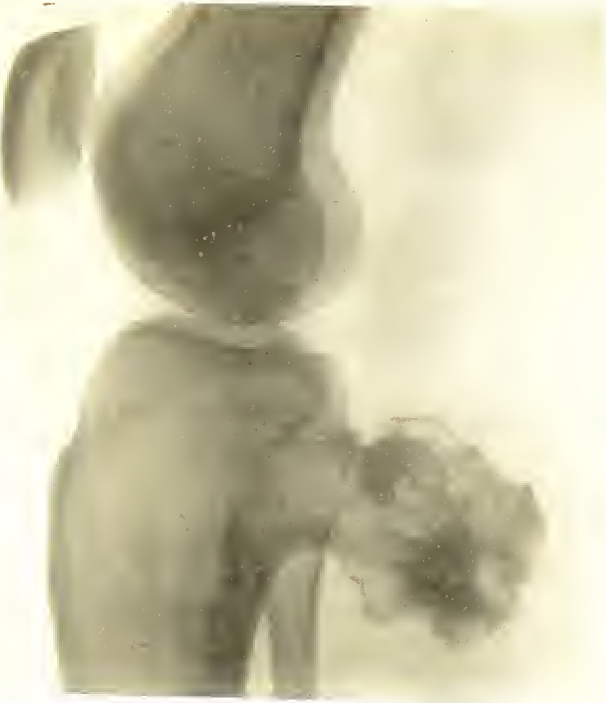


Fig. 1.—Exostosis (p. 324).

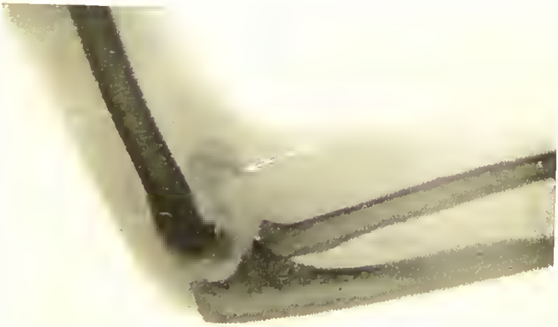


Fig. 2.—Traumatic myositis ossificans (p. 325).

PLATE V.

Periosteal sarcoma of femur.

PLATE VI.

the diaphysis be found later at some distance from the epiphysis. (Plate v., Fig. 1.)

A bony tumour or outgrowth extending along a tendon or in a muscle is the result of **myositis ossificans.** (Plate v., Fig. 2.) (*See* p. 268.) This is usually, if not always, the result of injury. The growth may be attached to a bone or quite separated from it. When it occurs as a low smooth deposit of bone on the surface of part of a diaphysis, it is impossible to distinguish it from a periosteal node, or from a commencing periosteal sarcoma, without careful exploration by operation and microscopical examination of the tissue causing the swelling and of the adjacent muscle.

If the tumour occurs in the hand or foot of a young person, is of slow and painless growth, smooth and globular in outline with rounded projections from the surface, is firm but not absolutely unyielding to pressure, and the skiagram shows the bone expanded over a mass nearly transparent to X-rays, a diagnosis of central **enchondroma** may be arrived at. These tumours are frequently multiple.

A steadily enlarging swelling, starting at the end of a diaphysis of a long bone, growing along the bone and more or less ensheathing it, is a **periosteal sarcoma.** In a skiagram (Plate vi.) the tumour is slightly opaque, with fine striations at right angles to the bone on which it grows. It may attain a great size, and through the stretched skin enlarged veins may be seen. Its consistence varies; part may chondrify, and ossification, spreading from the surface of the bone, plainly shown by X-rays, is common. The affected bone is usually eroded, and the tumour may penetrate into, and luxuriate in, the medulla; spontaneous fracture is liable to occur. Very occasionally, a periosteal sarcoma shows no tendency to ensheathe the bone, but forms a globular outgrowth from the bone.

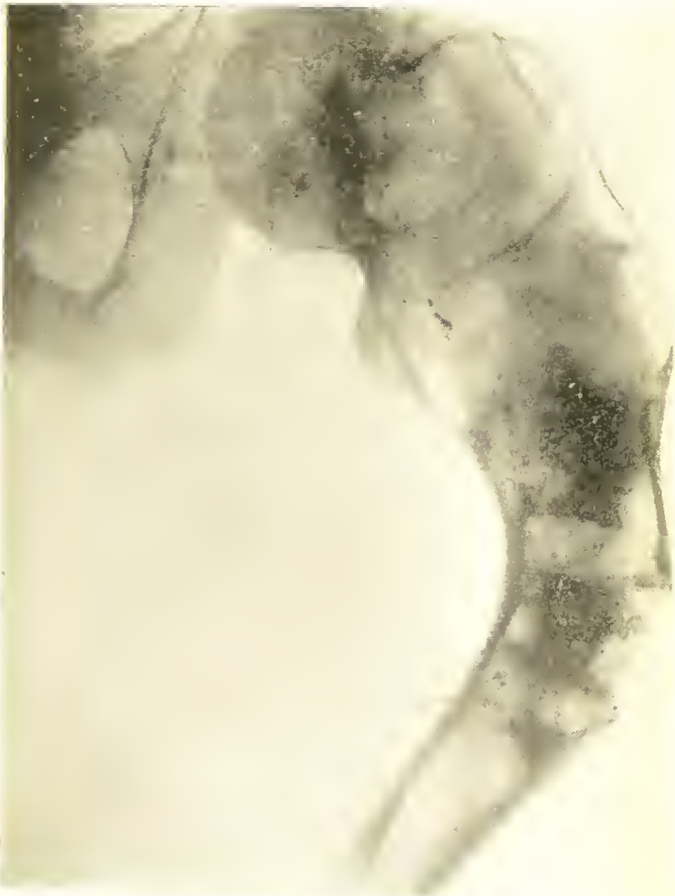
A swelling on a flat bone—e.g. the scapula or the innominate bone—which rapidly extends along its surface and quickly appears on its opposite surface, firm in consistence, smooth or slightly lobed in outline, is a **periosteal sarcoma**. The rapidity of growth and the great size attained are very striking features of these tumours in their later stages. It is doubtful if pulsation is ever observed in this form of the disease.

A steadily progressing enlargement of a long bone, shown by a skiagram to be due to a swelling within the bone which has replaced the cancellous bone and expanded the outer compact bone, is either a *myeloma*, *central sarcoma*, or *osteitis fibrosa*, with cyst-formation.

If the skiagram shows that the swelling is towards the end of the bone, very transparent to X-rays, the shadow being without mottling or striation, more or less globular in form, and the shell of bone, though thin, is unbroken, it is a **serous cyst**, or the result of **osteitis fibrosa**. (Plate VII.) In this disease the swelling develops slowly and may be arrested. Spontaneous fracture may be the first evidence of the condition. The humerus and the femur are the bones most commonly affected by this disease.

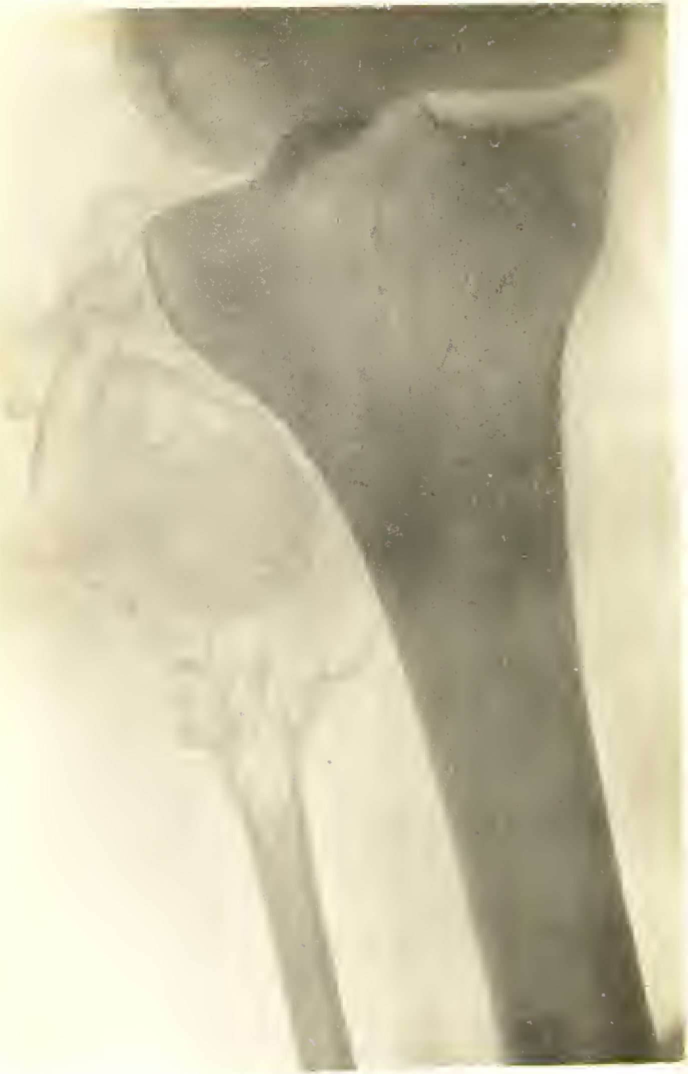
If the central swelling of the bone involves the epiphysis largely, stretches and flattens the adjacent articular cartilage, fungates through the thin layer of compact bone, but does not grow with great rapidity, it is a **myeloma**. (Plate VIII.) In the skiagram this tumour gives a shadow in which faint mottlings or striations are seen.

If the central tumour differs from the above by



Osteitis fibrosa of femur, with cyst-formation.

PLATE VII.



Myeloma of fibula.

PLATE VIII.

involving the diaphysis more extensively, and by more rapid growth, greater destruction of bone, and earlier spontaneous fracture, it is a **central sarcoma.** Egg-shell crackling of the thinned expanded bone and pulsation of the tumour may be felt both in myeloma and in central sarcoma. A moderate enlargement of the diaphysis of a long bone with moderate expansion of its medullary cavity, and the replacement of the medulla by a tissue which gives a mottled shadow in the skiagram, may be an **endothelioma.** This rare tumour affects the diaphysis rather than the epiphysis of a bone, tends to spread far along the interior of the bone, and does not absorb bone so rapidly or so extensively as does a central sarcoma.

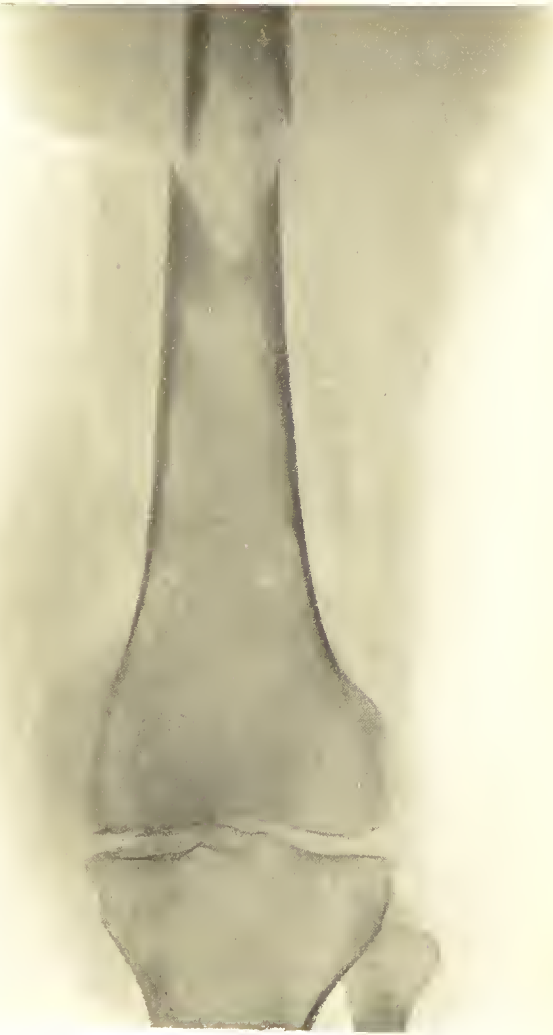
A swelling in a bone of a patient who has or has had carcinoma elsewhere—particularly in the breast or thyroid gland—is probably a **secondary carcinoma** of bone. (Plate IX.) Its destructive effects upon the bone may be evidenced by the occurrence of spontaneous fracture, or the skiagram may show the replacement of bone by a less opaque, slightly mottled, and irregular substance. Such a growth is usually painful, but the occurrence of a spontaneous fracture may be the first symptom noticed.

A smooth, more or less globular enlargement of a bone, shown by a skiagram to be due to a substance transparent to X-rays, which has rarefied and expanded the bone, may be a **hydatid cyst.** If there is excess of the eosinophile cells of the blood, and if the patient has or has had hydatid disease elsewhere, the diagnosis is confirmed. The diagnosis is more readily made if the patient has lived in Australia, northern New Zealand, or Iceland, where hydatid disease is common. The disease may be only discovered on the occurrence of spontaneous fracture.

It is met with in flat bones, as well as in either the shaft or the joint-ends of long bones.

A soft or elastic, finely lobulated tumour with a limited attachment to a bone is a **lipoma.** These tumours are always congenital, and the diagnosis is more readily made if this fact is brought out in the history.

If a tumour in connexion with the shaft of a bone grows very slowly, assumes a smooth globular outline, and is firm and painless, a **fibroma** may be diagnosed. In general features it will most nearly resemble enchondroma, from which it can only be distinguished by its position: ossifying enchondromata start from the junction of epiphysis with diaphysis, and central enchondromata affect the long bones of the hand. From sarcoma it will be differentiated by its more chronic course, its very slow growth or even stationary character, and the absence of fracture or pulsation. Fibroma is a very rare tumour of bone, except in the form of fibrous epulis.



Secondary carcinoma of femur.

PLATE IX.

CHAPTER XXV

DIAGNOSIS OF DISEASES OF JOINTS AND BURSÆ

IN this chapter an attempt will be made to enable the reader to examine intelligently and purposively, and then to arrive at a correct diagnosis of, any disease of a joint or of the structures immediately surrounding it.

It will be convenient to consider, first, the general principles of diagnosis of articular disease, and then to refer in detail, where that is necessary, to the diagnosis of affections of individual joints.

When such a case presents itself to the surgeon the first fact to be ascertained is whether there is any organic disease of the part, for it must be borne in mind that **hysteria**, or **neuromimesis**, often closely imitates grave articular lesion. Hysteria is more common in women, but it is not limited to either sex, or to any age; in many cases it may be traced to the influence of some strong emotional disturbance.

The main fact upon which the diagnosis of hysteria must rest is the want of correlation of the symptoms. Thus, when a patient complains of pain n a joint of a very severe character, especially if his is accompanied with marked superficial hyperesthesia, but there is no discoloration or heat or welling about the part, or wasting of the muscles f the limb, an hysterical joint must be suspected. If it is found that the joint is held rigid—usually in the position assumed in disease, but sometimes strikingly different, as e.g. in the position of extreme extension—and that all attempts to move it excite spasms of the muscles and cries from the patient, but that when the attention is diverted passive movement can be made without difficulty or pain, or that the patient herself moves the part, this suspicion becomes converted into a positive diagnosis. A skiagram does not show any of the bone changes always found in organic joint disease of long standing. In cases where the surgeon remains in doubt, the history of some strong emotion, or of the witnessing of a case of real joint disease just before the onset of the illness, or the presence of other hysterical phenomena, such as exaggerated reflexes, will be of assistance; and it may be useful to place the patient under the influence of an anæsthetic and to examine with care the outline and mobility of the joint, and particularly to notice when the joint becomes rigid, for it is stated that in neuromimesis the rigidity only reappears when the patient's consciousness returns, while in painful organic disease it comes on as soon as the deep anæsthesia passes off. Slight ill-defined general swelling may be met with as the result of the use of stimulating liniments; and in cases of long standing, wasting of the muscles from mere lack of use may be observed, but it is never so marked as in cases of organic disease.

The **examination of a joint** should give information on three main points: (1) the condition of the joint structures—synovial membrane, bones, cartilages, ligaments, and muscles; (2) the range, smoothness, and painlessness of the joint movements; and (3) the condition of the tissues around the joint.

The best *method of examination* is first of all to look at the joint carefully, next to feel it, then to study its movements, both active and passive, and to supplement this by a study of good comparative skiagrams of the diseased joint and of the corresponding healthy one. By *inspection* of a joint we can learn the relation of the bones to one another, the attitude assumed, and the general form of the part, whether swollen, deformed, or wasted. By *palpation* we can determine more accurately whether a swelling corresponds to the outline of the synovial cavity, to one or more of the bones, or to neither of the joint structures; whether the swelling is solid or fluid, and whether any one of the joint structures is tender to pressure through it. Observation of the *mobility* of a joint tells us not only the range of movement, whether normal, limited, or excessive, but also whether it is smooth or uneven, painless or painful. *Skiagrams* show changes in the structure and density of the articular bones, as well as in their outline and relations. They may show changes in the soft parts too, such as effusions, abscesses, cysts, and new growths.

I. THE STRUCTURES INVOLVED

Disease in the neighbourhood of a joint often simulates disease of the joint itself; it is therefore very important to notice whether any swelling present corresponds in outline with some neighbouring structure, such as a bursa or synovial sheath, and not with the articular cavity or either of the bones. Movement of a joint is usually attended with movement also in adjacent bursæ and synovial sheaths, and pain and creaking due to disease of the latter may be mistaken for articular pain and creaking. To avoid this error, notice the exact seat of the pain and creaking, and especially whether these signs can be elicited by manipulations which cause movement in the bursa or synovial sheath in question without movement of the joint. For example, the prepatellar bursa can be tested by moving the skin over the front of the knee; the synovial sheaths of the ankle or wrist can be tested by moving the digits while the ankle- or wrist-joint is held fixed.

When a swelling is found which corresponds in outline to some neighbouring structure, as a bursa or synovial sheath, and not to the articular cavity or to any of its bones, and if at the same time there is no alteration in the mobility of the joint, or pain produced by it unless it excites it in the inflamed structure outside, it will be at once known that the disease is extra-articular; such cases are of common occurrence, e.g. housemaid's knee, and teno-synovitis of the wrist or ankle. On the other hand, when a swelling corresponds in outline to the synovial cavity of a joint, or to one of the articular bones, or when the motion of a joint has lost its smoothness, or is painful, or the articular bones are found sensitive to pressure or shocks transmitted through them, it may be judged that the actual joint structures are involved.

1. When a swelling is present which corresponds in outline to the synovial cavity, or movement of the joint is attended with soft creaking, the disease is affecting the **synovial membrane** of the joint. The changes met with in the synovial membrane are mainly three: (i) effusion of blood, serum, or pus into the cavity, distending it more or less; (ii) infiltration of the synovial membrane causing thickening of the tissue, tuberculous, syphilitic, or sarcomatous; and (iii) hypertrophy of its fringes, rendering the surface villous.

2. The signs of disease of **ligaments** are, in

the early and acute stage, tenderness, especially at the attached end of a ligament, pain on any movement which stretches the ligament, and later on displacement of bones, or an abnormal range of mobility in the joint, from shortening or from lengthening of the ligaments. Ligaments are never the only structures of a joint affected by disease, and these signs therefore are always combined with others.

3. When the movement of the joint has lost its usual smoothness and is accompanied by hard grating or a soft rubbing or a crackling sensation, or, again, when nodular growths can be felt springing from the edge of the articular cartilage, the disease is known to be affecting the **cartilage.** In the acute diseases of joints the occurrence of severe starting-pains, especially just as the patient is falling asleep, is regarded as evidence that the articular cartilage is involved. Disease very rarely, if indeed ever, begins in articular cartilage.

4. If an articular bone is found swollen, and tender on pressure, and if pain is excited by force transmitted through it, or if the skiagram shows alteration in the outline or in the intimate structure of the bone, it will be known that the **articular bone** is diseased.

5. If a swelling corresponds in position and outline to a bursal cavity, or there is soft friction felt on movement of the walls of a bursa over one another while the neighbouring joint is at rest, it will be evident that the disease is in a **bursa.**

6. And when a swelling corresponds in position or outline to a tendinous synovial sheath, or pain and soft grating are elicited by movement of a particular muscle or muscles while the adjacent joint is kept at rest (where this is possible), the diagnosis of disease of a **synovial sheath** is obvious.

7. Lastly, a swelling or other morbid phenomenon may not correspond with any special structure, but may involve the common connective tissue of the part.

Many joint diseases affect more than one of the above structures, either primarily or in succession, and in the latter case it may be impossible to tell where the disease originated; but wherever it is possible, and certainly in all cases of early disease, a careful attempt to localize the affection will usually be attended with success.

II. NATURE OF THE AFFECTION

The surgeon must next determine the nature of the affection present. Inflammation in its various forms is the most frequent disease, and its symptoms are like those observed in other situations. Degenerations and neoplasms are also met with.

A. Acute disease.—The acute diseases of joints most often affect mainly the synovial membrane and are characterized by more or less rapid and abundant effusion of fluid into the cavity. Where the effusion follows immediately upon a severe injury to the joint, especially a fracture of one of the bones into the joint, e.g. the patella, it is an effusion of blood—**hæmarthrus.** Signs of bruising of the soft parts, or their subsequent staining with blood pigment, would confirm this diagnosis. A sudden effusion into a joint after even moderate use of the part, or some trifling strain, in a patient with the history and evidences of *hæmophilia*, is also to be recognized as hæmarthrus.

A rapid effusion of fluid into a joint, either spontaneous or quickly following over-use, or sprain, or an "internal derangement" of the joint, is in nearly all cases at first a **serous synovitis.** With this there may be some local heat, slight redness of the skin if the joint is not thickly covered in, pain on and limitation of movement, and some pyrexia. When the pain is severe, and there are acute local tenderness, and great pain on movement, and the outline of the joint is blurred by swelling outside the synovial membrane, the *ligaments of the joint* are also acutely inflamed.

When the swelling steadily increases and is supplemented by superficial œdema, and the local pain, tenderness, heat, and redness become more marked, **suppuration** is indicated. With the formation of pus in the joint cavity the fever increases, the daily range of temperature becomes greater, and there may be a rigor. In all cases of doubt, and where from the nature of the case suppuration is likely to occur, some fluid should be removed from the joint with an exploring syringe to determine its nature. A bacterial examination of the fluid removed should be made, to determine the causative organism. In pyæmia suppuration occurs in joints not only very rapidly but without much pain or local œdema.

There are many forms of **acute synovitis** and **arthritis** which must be distinguished. For this purpose inquire carefully into the apparent cause of the malady, especially injury, over-use, or sudden slipping or locking of the joint. Notice whether more than one joint is affected, and inquire into the previous history of the patient, immediate and remote, particularly for evidence of rheumatism, gout, gonorrhœa, syphilis, pyorrhœa, or suppuration in any part of the body.

1. When the synovial effusion quickly follows upon an injury such as a sprain, or upon over-use, or any form of "internal derangement" of the joint, it is a case of *traumatic synovitis.*

2. When the inflammation quickly follows a

wound into the joint cavity, is intense and rapidly runs on to suppuration, it is the result of infection of the joint with *pyogenic organisms*, and the particular organism must be identified.

3. A synovial effusion which has developed rapidly and insidiously, i.e. without acute local pain and bright redness of the skin, in a patient suffering from fever with considerable daily range, possibly interrupted by a rigor or rigors, with sweating, wasting, and general illness out of proportion to the joint affection, is *pyæmic synovitis*. The effusion is purulent from the first, and contains streptococci, or, less commonly, staphylococci or one of the specific pus-producing organisms. Several joints may be affected, and the cartilage and bone are liable to be eroded. In almost every case the primary focus of disease is quite obvious.

4. An acute inflammation of a joint coming on during or soon after an attack of *pneumonia*, *typhoid fever*, *influenza*, or *scarlet fever* is due to infection of the joint with the specific organism of the disease. Wherever possible the organism should be identified. As a rule, the effusion in these cases remains serous, but in the pneumococcal variety it frequently becomes purulent. Pneumococcal arthritis also occurs apart from any other pneumococcal lesion. Exactly similar joint affections may be caused by pyorrhœa, or by chronic suppuration in the nasal sinuses, alimentary or genito-urinary canals.

5. An acute swelling of a joint coming on spontaneously in a patient who has gonorrhœa or gleet is *gonorrhœal arthritis*. Cases vary much in severity; there is usually, in addition to synovial effusion, some swelling of the ligaments of the joint, and more pain and tenderness than in a simple synovitis, suppuration may occur, and ankylosis often results. The

disease attacks the large joints, especially the knee, ankle, and wrist; it may be associated with inflammations of fasciæ and aponeuroses. The gonococcus can frequently be found in the fluid in the joint. This disease may come on at any time during the course of gonorrhœa, and when the local evidences of this disease are only to be detected by careful examination.

6. If several joints are simultaneously or successively attacked with moderate, general, ill-defined swelling, and the parts are found slightly red, tender, and very painful on any movement, and along with this local condition there are acute pyrexia, profuse sour-smelling perspiration, concentrated acid urine, a coated tongue, and particularly if there is pericarditis, endocarditis, or pleurisy, or a history of previous attacks, the surgeon will recognize the joint affection as a part of *acute articular rheumatism.* The number of joints affected, the rapid onset and subsidence of the local lesions, the character of the general disturbance, and the history of previous attacks are the main points on which to found a diagnosis.

7. If a patient is seized in the night with a very severe pain in a joint which in a few hours becomes swollen, with a red glossy appearance of the skin over it, and œdema of the subcutaneous tissue, the part being exquisitely tender, and the temperature is only moderately raised, it will be recognized as *acute gout.* This diagnosis will be confirmed if the affected joint is the metatarso-phalangeal, if previous similar attacks have occurred, and particularly in that joint, and if there are other evidences of gout such as tophi, dyspepsia, cramps, or excess of uric acid in the blood.

8. A slightly painful effusion into a joint arising

spontaneously in a patient who is the subject of early secondary syphilis is *syphilitic synovitis.* The diagnosis is confirmed by a positive Wassermann reaction and by rapid resolution under anti-syphilitic treatment. Syphilitic synovitis occurs also in the congenital type of the disease and takes the form of a painless, rapid effusion into one of the large joints, unaccompanied by any limitation of movement, and with a tendency to recur from time to time.

9. If in an infant or a young child a joint—especially the hip or shoulder—becomes acutely swollen, with great local tenderness and pain on any movement, and the child is very ill with high fever, it is a case of the *acute arthritis of infants*, due to infection of the joint with virulent pyogenic organisms, and quickly resulting in suppuration and more or less destruction of the joint, dislocation, etc.

10. Where a joint becomes suddenly and spontaneously greatly distended with fluid, and there is neither pain nor tenderness, nor marked limitation of movement, it is *Charcot's disease—ataxic arthropathy*, and the reflexes, the pupils, and the sensation in the limbs should be examined for evidence of tabes or of syringo-myelia. (*See* p. 342.)

11. If there is a fluctuating swelling in the position of a bursa, with pain, tenderness and redness of the skin, and some pyrexia, it may be diagnosed as *acute bursitis ;* and if the surrounding tissues become œdematous, the pain throbbing in character, and the temperature still more raised and variable during the day, it indicates that *suppuration* has occurred. This affection is most frequently seen in the bursæ over the patella and the olecranon, or in a bunion, and is often the result of a wound.

12. If the patient complains of sharp pricking pain in the site of a bursa, and it is found tender

on pressure and yields soft crepitus or friction when the part is so pressed or moved as to glide the two surfaces of the bursa over one another, it is to be recognized as *subacute plastic or dry bursitis.* This is seen most often and is most readily diagnosed in the prepatellar bursa.

13. An acute swelling over a tendon sheath, with creaking on moving the tendon in its sheath, is *acute teno-synovitis ;* this is most often seen in the wrist and ankle, as the result of strain or overuse, or as a complication of gonorrhœa, but it may be rheumatic or gouty.

B. **Chronic disease.**—In examining a chronic joint affection, notice particularly the following points :

i. The presence of effusion into the joint cavity, and its amount.

ii. Thickening of the synovial membrane, and of the parts around the joint.

iii. The shape of the bones, whether enlarged, worn away, or greatly absorbed.

iv. Partial or complete displacement of the bones, due to alteration in their shape or to changes in the ligaments.

v. The structure and density of the bone, as shown in the skiagram. This will also show the outline and relative positions of the articular bones.

vi. The movement of the joint—whether smooth or rough ; normal, limited, or excessive in range ; painful or painless ; even or liable to locking.

vii. The seat and character of pain present, the influence upon it of movement and of pressure through the bones.

viii. The muscles, whether rigid or wasted.

ix. The presence of an abscess or sinus.

x. The history of the affection and the existence of other signs of diathetic or nervous disease.

1. When there is simply synovial effusion, and particularly when it follows upon an injury or persists after an acute onset, and there is no evidence of tubercle, gonorrhœa, syphilis, hæmophilia, or tabes dorsalis, it is a **chronic serous synovitis.**

2. When with, or without, moderate effusion into the joint the synovial membrane is found to be thickened, and the movement of the joint is limited, and using it soon brings on pain, the condition is **tuberculous synovitis.**

3. If there is an ill-defined swelling of a joint, giving it a more or less globular outline, and the joint is held rigid by the muscles, and movement is painful, and the bone or bones feel enlarged and are tender to pressure, the case is one of **tuberculous arthritis** involving the bone. Tuberculous disease of joints runs a variable course, and its signs differ in successive stages of the disease; its main features are its insidious onset (sometimes there is a distinct history of injury), its chronic course, the signs of infiltration of synovial membrane, of bone, and later on of ligaments, the tendency to softening of the tuberculous tissue into so-called abscesses which may burst and lead to chronic sinuses often connected with carious bone, and in the worst cases dislocation or destruction of the joint. Great wasting of muscles, starting-pains, pallor, and other tuberculous symptoms are further accompaniments often met with. Until abscess forms, the skin over a tuberculous joint is not reddened, although the part is a little hot to the hand: this fact gave rise to the old name of "white swelling" of the joint. A skiagram will show rarefaction or

erosion of the bone at the site of the bony deposit, with irregularity of the articular surface when the process has reached the joint cavity.

4. If a joint slowly enlarges, with little or no pain, and a firm brawny infiltration of the synovial membrane and ligaments is found, and particularly if this infiltration involves only a part of the joint, or if it spreads slowly to the surface and then ulcerates and sloughs, the case is one of **syphilitic gummatous arthritis.** A history of syphilis, and a positive Wassermann reaction, make the diagnosis certain.

5. Very rarely a similar condition accompanied by bony changes and some creaking occurs in children suffering from congenital syphilis and is known as **chondro-arthritis syphilitica of Virchow.**

6. When a joint slowly becomes stiffened and movement in it is painful, and the bones are found to be the seat of nodular thickenings on the margin of the articular surface, and movement of the joint is attended with creaking or grating from roughness of synovial membrane and cartilages, or erosion of the cartilages, and a skiagram shows rarefaction of the bone with lipping of the articular surface, or osteophytic growths, the condition is **osteo-arthritis,** or **arthritis deformans.** Of this disease there are several varieties:

(*a*) *Osteo-arthritis of children*, or *Still's disease*, in which the disease comes on insidiously, is attended with marked thickening of bones, and is accompanied by enlargement of the spleen and lymphatic glands. It is distinguished from syphilitic arthritis by the Wassermann reaction being negative. It quickly leads to ankylosis.

(*b*) *Acute osteo-arthritis*, which comes on in adolescents and young adults, attacks many joints, runs a rapid course, leads to great deformity and stiffness, and may entirely cripple the patient.

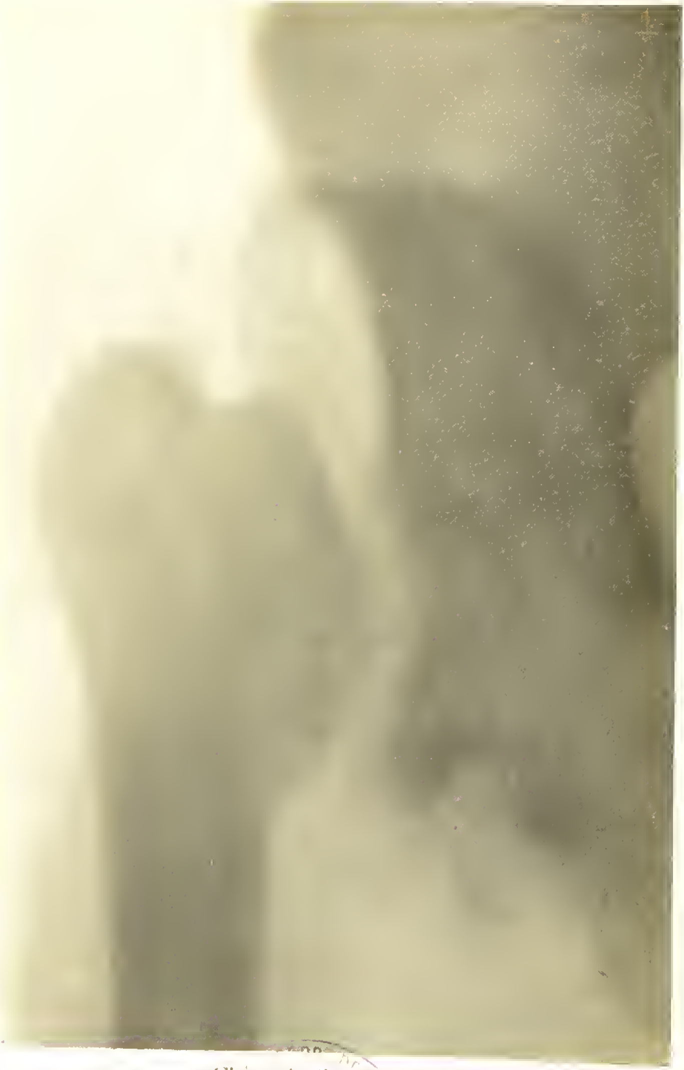
(*c*) *Chronic osteo-arthritis of middle age*, attacking several joints, especially those of the fingers and the knees, running a slow and often intermittent course, and more frequent in women than in men.

The ultimate cause of these two varieties, (*b*) and (*c*), lies very frequently in an ascertainable focus of chronic infection or toxæmia, and the presence of oral, nasal, or pelvic infection, or of intestinal stasis or toxæmia, should be sought for.

(*d*) *Monarticular osteo-arthritis* or *traumatic osteo-arthritis*, following on an injury to the joint or to the bones of the limb, or coming on after prolonged strain, as of the hip-joint in labourers. It is attended with considerable but varying pain, and leads to much deformity and stiffness.

7. When a joint has become abnormally mobile (e.g. lateral mobility in an extended knee), with very marked grating in the joint and considerable deformity from absorption of bone, displacement of joint-ends, nodular outgrowth of bone, or effusion, and these changes have occurred rapidly and painlessly, it is **Charcot's disease** of the joint—**ataxic arthropathy**. (Plate x) The onset is usually acute and attended with great effusion, and the disorganization of the joint occurs rapidly. The disease is much more rapid in its course than osteo-arthritis, and is also distinguished from it by its painlessness. A skiagram shows in the ball-and-socket joints (hip and shoulder) great destruction of the bones; in the hinge-joints, on the other hand, there is pronounced new formation of bone. Signs of tabes or of syringomyelia are usually to be found.

8. If the patient has experienced several attacks of acute pain, tenderness, and swelling of a joint.



Charcot's disease of hip.

Note extensive destruction of head of femur.

PLATE X.

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and the part is found permanently enlarged, with a smooth or nodular deposit around it, either fixed to the bones or movable over them, and the joint is either ankylosed or moves without creaking or grating, and especially if the disease occurred first in the joint of the great toe, and there are other signs of gout such as tophi, rigid arteries, dyspepsia, excess of uric acid in the blood, it is **chronic gout**. The position of the disease, its onset by successive acute or subacute attacks, the character of the "chalk-stones" and the other evidences of gout distinguish this from arthritis deformans; it is more common in men than in women.

9. For the diagnosis of **sarcoma of epiphyses** of bones, *see* p. 325. A soft sarcoma springing from a bone may burst through into the synovial cavity and fill it out, and so simulate synovitis; the diagnosis will be determined by the swelling not being limited to the joint cavity, by its constant growth, and by a puncture yielding only blood; later on by ulceration of the skin, and fungation of the tumour.

10. If, during movement of a joint, it becomes locked in the flexed position, with intense, sickening pain, the presence of a **loose body** in the joint must be suspected; and if the attacks recur from time to time, while under some sudden passive movement both the pain and the immobility abruptly pass off, and particularly if the cartilage can be felt moving within the synovial cavity, the diagnosis becomes certain. Such a loose body is either a detached portion of an interarticular fibro-cartilage or the articular cartilage plus a scale of the subjacent bone, or a cartilaginous or bony nodule in the synovial membrane. The previous history of a wrench of the joint, or of a direct blow, or of osteo-arthritis may point definitely to one of these. In some cases

the "loose body" is felt by the patient and the surgeon, and the diagnosis is made previous to its slipping between the bones and causing the severe pain. A good skiagram may show the loose body, especially when it consists partly of bone.

11. A fluctuating tumour occupying the position of a bursa, with no local heat or redness of the skin, and but slight pain, and no tenderness or pyrexia, is to be diagnosed as **chronic serous bursitis.**

12. When, in the position of a bursa, a soft grating sensation occurs on moving the part, or a small movable body or bodies can be felt, it is a case of **chronic polypoid bursitis.** There may be more or less effusion into the bursa.

13. A chronic effusion into a bursa with moderate thickening of its wall is a **tuberculous bursitis.** This may ulcerate through the skin and lead to a tuberculous sinus. It may be a sequel to tuberculous osteitis.

14. When, at the site of a bursa, a very firm tumour slowly forms, and either steadily grows or, having attained a certain size, becomes arrested, it is **chronic plastic** or **fibrous bursitis.** Ossification, suggested by extreme hardness and proved by an X-ray picture, is not unknown as the final stage of this condition.

15. A tense globular fluctuating cyst, not adherent to the skin, but found to be adherent to a synovial sheath, or to a joint, or to be reducible into a joint by gentle continuous pressure, is a **synovial cyst.** These cysts are most common on the back of the hand and dorsum of the foot; but they are also met with in connexion with other joints and synovial membranes, particularly in cases of osteo-arthritis, and are then known as Morrant Baker's cysts. The cyst may be found at some distance from the joint with

which it is connected, e.g. in the middle of the arm, in the upper third of the forearm, or in the calf.

16. A chronic effusion into a synovial sheath, with thickening of its walls, is **tuberculous tenosynovitis**. The effusion often contains "melon-seed bodies," giving rise to characteristic fremitus.

III. Special Features of Diseases of Individual Joints

Shoulder-joint.—Owing to the deep position of this joint, distension of its synovial cavity does not readily give rise to a fluctuating swelling, and only in some cases can a soft elastic or fluctuating protrusion be felt in the axilla; but in *acute synovitis* the joint is held fixed, and the prominence of the shoulder is increased. When a chronic effusion is present, as in Charcot's disease, the arm may be lengthened; the head of the humerus can be pushed up into its proper place, and then felt to fall again.

When the prominence of the shoulder is considerably increased, and fluctuation is detected through the deltoid muscle, or from its anterior to its posterior border, while the joint is not fixed, nor its movement painful provided that the limb is kept abducted to relax the deltoid muscle, the surgeon will diagnose *effusion into the bursa beneath the deltoid.*

Tuberculosis of this joint may be insidious in onset, and quiet in its course, leading to fibrous ankylosis without any complaint of pain or any signs suggesting effusion or softening of tuberculous tissue.

Elbow-joint.—Distension of the synovial cavity is most apparent on the outer side of the olecranon and over the head of the radius: sometimes it causes the obliteration of the space between the olecranon and the inner condyle of the humerus, or bulging above the olecranon.

The ease with which each of the three bones entering into this joint can be felt renders the detection of disease limited to one or other of them comparatively easy. The only *bursa* in this situation liable to be inflamed is one placed over the olecranon under the skin ; effusion into it causes a swelling in the middle line of the joint behind, obscuring the olecranon, instead of on each side of that bone as in synovitis. The nearness of this bursa to the skin renders it especially liable to acute inflammation after blows upon or abrasions of this region.

For disease of the *wrist-joint*, *see* Chap. XLIX.

Hip-joint.—Three circumstances invest the diagnosis of diseases of the hip-joint with special difficulty and importance. The joint is so deeply placed and well covered with thick muscles that the actual joint itself cannot be felt, nor can distension of its synovial cavity be clearly defined. The lumbar spine is so movable that the actual relative position of the bones of the hip is concealed by compensatory rotation of the pelvis ; a flexed, abducted or adducted joint often appearing "straight." And, lastly, affections of certain neighbouring parts very closely simulate disease of the hip-joint itself. The examination of the hip should therefore be carried out with method and precision, and the following points should be investigated :

1. **Relative position of femur and innominate bone (os coxæ).**—To determine this, place the patient flat on his back on a firm mattress, and see that the spine is flat on the mattress and that a line between the anterior iliac spines crosses at right angles one drawn from the xiphoid cartilage to the symphysis pubis. In such a position of the spine and pelvis the lower

limbs should lie flat on the couch, they should be of equal length, and the thighs should be either parallel or slightly and equally adducted.

Departures from this normal standard come under two heads: the thigh may be held in some position in the usual range of mobility of the joint—flexion, rotation, abduction, adduction, or the femur may have a relation to the innominate bone impossible to a healthy joint—displacement.

When the joint is *flexed*, the thigh can still be placed straight down by tilting the spine into a position of lordosis; when this is marked, the hollow under the back is readily recognized. In order to detect a slight degree of flexion, and also to measure its amount, the surgeon should grasp the knee of the sound limb and raise the thigh until it lies with its whole length along the front of the trunk (i.e. the hip-joint is fully flexed), when the spine will be extended: if now the suspected limb still lies flat along the couch, there is no flexion of the joint; if, on the other hand, the diseased limb rises as the spine is extended by this manœuvre, it shows that the hip is flexed, and the vertical height of the knee above the mattress is a measure of the amount of flexion of the hip-joint.

Just as flexion of the lumbar spine can conceal flexion of the hip, so lateral rotation of the pelvis can conceal *abduction* or *adduction* of the femur. In a case of adduction of the hip in order to bring the two limbs parallel, the pelvis will be so raised on the diseased side as to bring the foot considerably above its fellow. Similarly, rotation of the pelvis downwards to bring an abducted limb to the ground makes it appear longer than its fellow. The influence of rotation of the pelvis upon the apparent length of the limb must never be forgotten.

Flexion is the most constant deformity observed in inflammation of the hip, but it is also observed in cases of ilio-psoas abscess, in effusion into the bursa beneath the psoas, and in some cases of peritonitis, appendicitis, and renal colic; it is not a feature of sacro-iliac disease unless complicated with ilio-psoas abscess. *Abduction* of the thigh is seen in the early stages of hip disease, i.e. tuberculosis, and in cases of synovitis; *adduction* is found in osteo-arthritis and in the later stages of hip disease, and it becomes exaggerated when the head of the femur is dislocated on to the dorsum ilii. *Rotation* of the femur is also produced by disease; *eversion* is seen when the synovial cavity is distended as in simple synovitis or in the early stage of tuberculosis, in any condition leading to tension of the ilio-psoas muscle, such as abscess in its sheath or in the bursa beneath it, and in coxa vara; *inversion* is found in osteo-arthritis and in the later stage of tuberculosis, especially when the femur is dislocated.

The mutual relations of the bony prominences of the hip should then be ascertained by comparative measurements on the two sides. (*See* p. 198.) The great trochanter may be raised to a slight extent, by absorption or by bending of the neck, by flattening of the head of the bone, or, to a more marked extent, by separation of the upper epiphysis of the femur and by dislocation of the femur. Approximation of the trochanter to the median line may be caused by coxa vara, by absorption of the neck or head of the bone, and by displacement of the femur through the acetabulum into the pelvis; on the other hand, undue prominence of the trochanter is caused by dorsal dislocation of the bone. The head of the bone may be felt in the buttock, or the extreme shortening, adduction and rotation of the thigh, together with a marked hollow in the groin, may indicate dislocation of the femur. A skiagram shows the exact position and outline of the bones.

2. **Mobility of the joint.**—Test its range, the character of resistance offered, its smoothness, and whether movement is painful or not. For this the left hand should be placed firmly upon the pelvis, and the right hand, grasping the knee, should first make gentle, and then more forcible, attempts to flex and extend, abduct and adduct, and rotate the thigh. Care should be taken to divert the patient's attention as much as possible while carrying out this manipulation. The surgeon should notice (1) whether the pelvis follows the movements of the thigh closely, or whether there is only a limited range of movement of the joint ; (2) whether the movement is painful, and, if so, whether, when the joint is fully flexed, rotatory and lateral movements are still painful and limited, or painless, free, and smooth ; (3) whether movement is attended with grating or crepitus, soft or hard, smooth or rough. Limitation of movement of the joint may be due to ankylosis, to muscular spasm, or to deformity or displacement of the bones. It is a very important sign of disease. Limitation of movement in one special direction, or in one position of the joint only, always indicates that it is due to some particular local condition and not to a general disease of the joint. Thus, when extension of the joint is painful and limited, but on full flexion the rigidity and pain in moving the thigh pass off, it indicates that there is spasm of the ilio-psoas muscle only, and careful examination should be made for abscess in its sheath, or between it and the capsule of the joint. If all rigidity passes off under an anæsthetic it is entirely muscular. In connexion with this symptom notice the tension of the adductor tendons and of the sartorius.

3. **Condition of the bones, their outline, and sensitiveness.**—The outline of the trochanter should first be compared on the two sides, and then, the palm of the hand being placed flat on the trochanter, firm and gradually increasing pressure should be made in the line of the neck of the bone; if this elicits signs of pain it indicates tenderness to pressure and inflammation of the neck or head of the femur. This sign should not be elicited by sudden blows upon the trochanter or upon the heel; in children the mere blow may cause them to cry, and in all patients alike unnecessary pain may be caused; when the heel is struck the position of the tender part cannot be precisely localized. The surgeon should next place one hand on the front of each iliac crest and attempt to press these two bones asunder or together, and to compress the pelvis laterally; by this means some slight movement is occasioned between the ilium and sacrum, and by the occurrence or non-occurrence of pain it may be inferred that that joint is, or is not, diseased.

4. **Swelling about the hip.**—Any swelling of the part should be carefully investigated; there may be simply indistinct fullness in the groin, or swelling of the inguinal glands, or a fluctuating collection of fluid. If the latter, care should be taken to notice whether it corresponds in position with the bursa under the psoas muscle, or with the sheath of the ilio-psoas, or with the bursa over the great trochanter of the femur, or is occupying the planes of cellular tissue of the part. A fluctuating swelling bulging above Poupart's ligament (ligamentum inguinale), just internal to the iliac crest, not reaching into the thigh at all, or only to the outer side of the femoral vessels, is an *iliac abscess*. A fluctuating swelling pointing above the middle of Poupart's

ligament, and extending into the thigh behind the femoral vessels to their inner side, is a *psoas abscess.* An abscess pointing above the brim of the pelvis is probably connected with disease of the acetabulum.

5. **Condition of the muscles, whether spasmodically contracted or wasted.**—Spasm is especially well marked in the adductor muscles; it is a sign that movement of the joint is painful. Wasting is especially seen in the glutei muscles, leading to flattening of the buttock and lowering of the gluteal fold. It is most often seen in *tuberculous disease of the joint,* and in *osteo-arthritis. Pain* in the knee, especially at the inner side of the joint, may be the chief or the only spontaneous pain in hip-joint disease.

The surgeon may diagnose *sacro-iliac disease* in cases where the limb is apparently lengthened, while the hip-joint can be fully extended, and there is no rigidity of, or pain in moving, this joint, whereas there is tenderness over the sacro-iliac joint, with pain on pressing the two innominate bones together or asunder. This is a disease of adult life; it comes on insidiously, the patients complaining of lameness, weakness and pain in the back and along either the sciatic or anterior crural nerve. An iliac abscess, which may cause flexion of the hip, but neither rigidity nor pain in moving it, or an abscess in the buttock or in the pelvis, possibly bursting into the rectum, may be found.

If the hip-joint can be moved in all directions and to the full extent without pain, and no pain is caused by firm pressure along the neck of the bone, and the skiagram shows the bones to be unaltered, the hip-joint and the articular bones may be regarded as free from active disease.

When the femur is rotated out, the great trochanter slightly raised on the pelvis, and the hollow of the groin a little filled out, and the skiagram shows the angle of the neck of the femur to be diminished, it is due to *coxa vara.* Abduction and rotation inwards are limited. This condition is most common in adolescents. (Plate XI., Fig. 1.)

If with similar limitation of movement of the hip of a child or adolescent, and a pronounced limp, without pain, there is found slight flexion of the joint, and perhaps some raising of the trochanter, and the skiagram shows a flattening of the head of the femur with increase in width of the epiphysial line, it is a case of *pseudo-coxalgia* or *Perthes' disease.* (Plate XII., Fig. 2.) The absence of pain and the characteristic X-ray appearance enable the condition to be distinguished from early tuberculosis.

If when a child begins to walk there is found to be considerable lordosis on standing, a peculiar rolling gait, and the top of the trochanter is about on a level with the front of the iliac spine instead of well below it, it is due to *congenital dislocation of the hip.* This may be bilateral and the parts symmetrical, or unilateral with the affected limb much shorter than its fellow, and the limp in walking correspondingly great As a rule, by drawing upon the limb the femur can be made to glide down over the ilium—telescopic movement. This excursion of the femur never occurs in pathological dislocation; it is one of the chief causes of the extensive lameness in this deformity. The skiagram will show the position of the head of the femur, and the imperfectly developed acetabulum. (Plate XI., Fig. 2.)

Pathological dislocation is always marked by considerable shortening of the limb, a hollow in the groin, and prominence of the raised great trochanter.

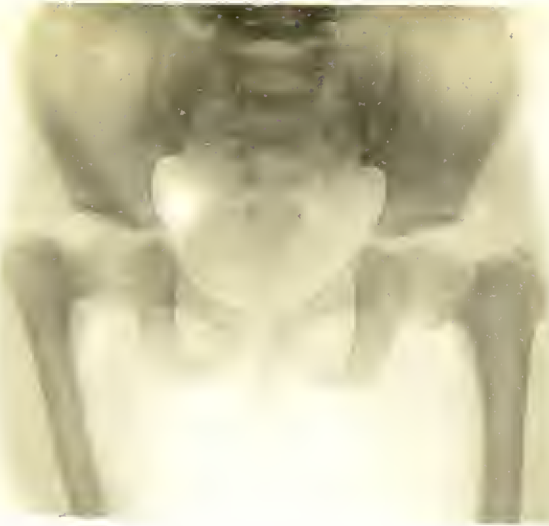


Fig. 1.- Coxa vara.

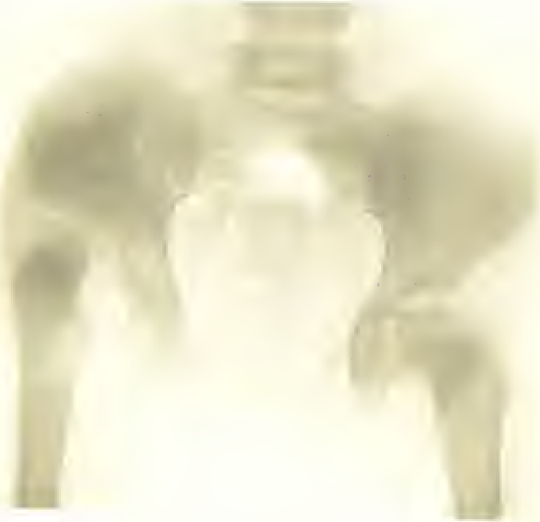


Fig. 2.– Congenital dislocation of hip.

PLATE XI.

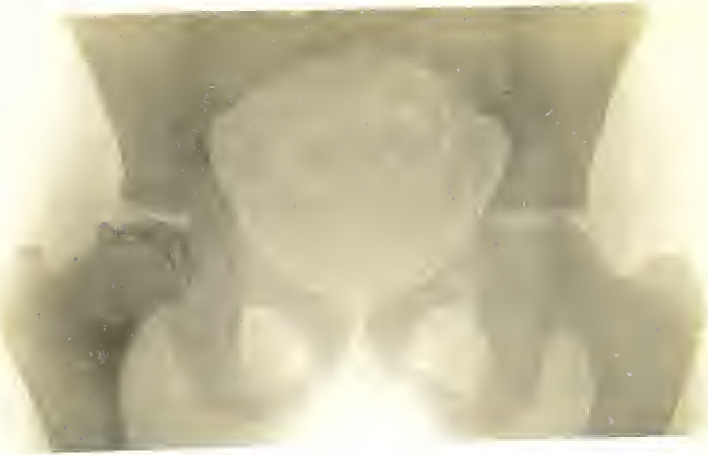


Fig. 1.—Tuberculosis of hip (p. 353).

Note irregularity of outline of head of right femur.

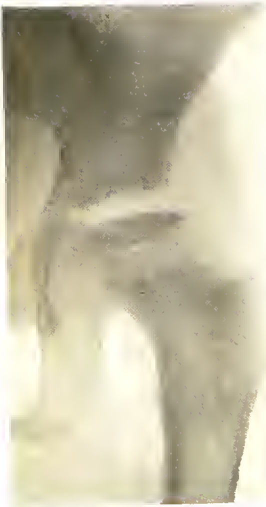


Fig. 2.—Perthes' disease (p. 352).

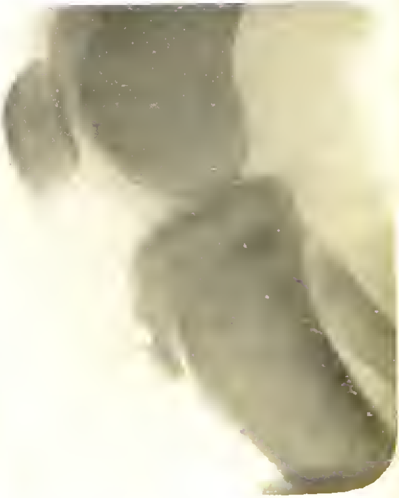


Fig. 3. Schlatter's disease (p. 211).

In Fig. note flattening of head and increased width of epiphysial line.

PLATE XII.

If the head and neck of the bone are unaltered there is marked adduction and internal rotation of the femur, and the rounded head can be felt in the buttock. This is seen after septic and enteric arthritis. If the head and neck of the bone have undergone much absorption, or the neck has separated from the epiphysis of the head, which still occupies the acetabulum, there is but little adduction or inversion. This occurs as a late result of tuberculous arthritis.

In the early stage of *tuberculous disease* of the hip the diagnosis rests upon fixation of the joint by muscular spasm, in a position of flexion, abduction, and external rotation, combined with painful limitation of movement in all directions, wasting of the glutei muscles with lowering of the gluteal fold. When the disease is confined to the bone there is marked tenderness of the bone to pressure.

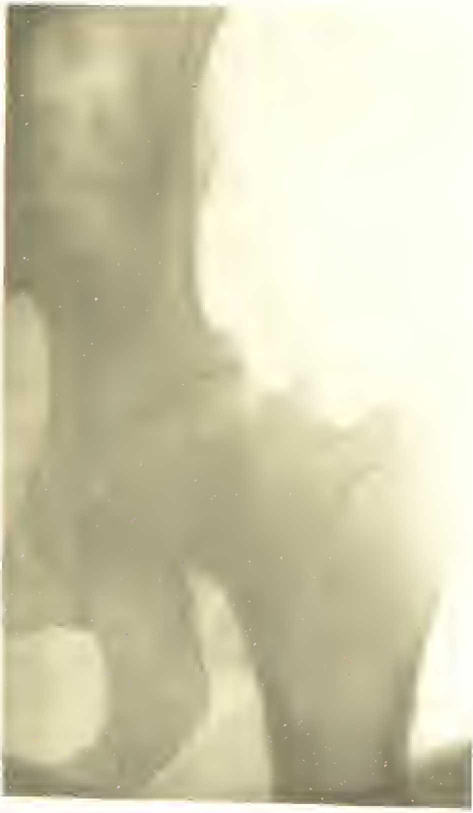
In late stages the position of the limb is one of adduction and inversion accompanied by real or apparent shortening. Abscess or sinus is also liable to be present. In all cases a *skiagram* is of great assistance; it not only shows rarefaction of the affected bone, but assists in eliminating other possible diagnoses. (Plate XII., Fig. 1.)

Disease of the pelvic part of the articulation may be suspected when abscess is found coming up from the inner surface of the pelvis to the brim, and pointing at the groin; or when a probe passed along a sinus strikes necrosed bone which does not move when the thigh is rotated; this sign may, however, be caused by separation of the head of the femur, but in that case the surgeon will notice that the trochanter turns upon its own axis, or round a much smaller circle than on the sound side. The skiagram will at once clear up this point in the diagnosis.

In *osteo-arthritis* the femur becomes adducted and a little flexed, and the range of movement is gradually reduced. The neck of the femur, too, becomes shortened. (Plate XIII.)

Inability to extend the thigh, and pain in attempting to do so, together with a fluctuating swelling deep in the groin, associated with freedom of flexion of the joint, and, when the joint is flexed, absence of all rigidity, and smoothness of motion of the femur in the acetabulum, are the signs whereby we can recognize *effusion into the bursa under the psoas.* This may be met with as a complication of disease of the joint. When the skiagram shows the articular bones to be healthy the diagnosis is very easily made. If a *psoas abscess* is present the spine, especially the lower dorsal region, must be carefully examined for evidence of caries; failing that, the pleural cavity and the kidney of the same side should be examined. When an *iliac abscess* is found, its cause should be sought for in disease of the lumbar spine, of the sacro-iliac joint, or of the ilium, or in inflammation around the cæcum or descending or pelvic colon.

Knee-joint.—This joint should always be examined with the limb extended. The synovial membrane extends on each side of the patella and above it; when distended it gives a smooth, elastic, fluctuating swelling in this position, and it floats the patella forwards away from the femur, upon which it normally rests. Then, when this bone is pressed upon at right angles to its surface, it is felt to yield, and presently to tap against the femur; this is what is known as "*floating of the patella.*" It is an extremely important sign of effusion into the joint, as it may be obtained when the amount of fluid is too small to yield either fluctuation or decided



Osteo-arthritis of hip.

PLATE XIII.

swelling. To test for this sign the knee must be extended and the rectus relaxed. The patient should therefore sit up in bed or on a couch, and the surgeon should grasp the thigh just above the knee with his left hand, and gently but firmly draw the soft parts down to relax the rectus, and to make sure of this he should note whether the patella is freely movable from side to side; he should then with the tips of two or three fingers of the right hand press the bone directly back, and if he feels it yield under the pressure, and then strike against the femur, the patella "floats." Unless there is something in the joint raising the patella, it always lies on the femur in every position. But if care is not taken, the surgeon may be deceived. Thus, if the bone is pressed obliquely or laterally it may be so moved on the femur as to simulate the tap of the "floating" patella; while if the amount of fluid is small or moderate, and the rectus is contracted, the bone may be pressed back on the femur by that muscle, or held so firmly that the symptom is not elicited. This is a constant sign of fluid in the knee-joint, and the only other condition causing it is the presence of a very soft neoplasm in the joint.

Another reliable test for fluid in the knee-joint is made as follows: Grasping the thigh just above the knee with one hand, pressure is made downwards towards the patella; with the finger and thumb of the other hand, pressure is made on the synovial pouches on either side of the patella. If fluid is present a *sense of fluctuation* is imparted to the first hand, the fluid being expelled from the joint cavity into the extension of synovial membrane under the quadriceps tendon.

In all acute and subacute inflammations of the joint it assumes a position of *moderate flexion with* *rotation outwards of the tibia* ; if the head of the tibia becomes displaced backwards on the femur it shows that the hamstring muscles are spasmodically contracted, and that the crucial and lateral ligaments have yielded to their traction ; this displacement, therefore, is an important sign of the extension of the disease to the ligaments.

Excessive lateral motion in the joint is sometimes seen as the result of stretching of the ligaments in hydrarthrosis and in Charcot's disease. *Partial displacement of the tibia backwards* with external rotation is frequently seen in the later stages of tuberculous disease. It is a sign of more or less destruction of the anterior crucial ligament. *Tenderness* over the attachments of the internal lateral ligament is not uncommon after acute synovitis.

The bones are so superficial that their condition can be well investigated. It must be remembered that the patella alone may be involved in acute or chronic inflammation ending in either necrosis or caries.

Loose bodies are more frequent and more often occasion acute and characteristic symptoms in the knee than in any other joint. The joint is also liable to *tearing and displacement of a semilunar cartilage* (meniscus), giving rise to momentary fixity of the joint and severe pain, often followed by an attack of subacute synovitis. These symptoms are like those met with in "loose body" in the joint, and the diagnosis of the case depends upon noticing that the trouble first occurred as the result of a violent rotation of the knee, and recurs only during rotation, that the seat of pain is always over one or other semilunar cartilage, that at the time some projection of the cartilage may be felt, or possibly a depression if it is displaced inwards, and that no "loose body" can be felt in the joint ; the pain is not so great in displacement of a meniscus as in impaction of a "loose body." (*See also* p. 207.)

There are a number of **bursæ** around the knee-joint, the position of which must be remembered.

A swelling on the front of the knee, obscuring the lower half of the patella and the upper part of the patellar ligament, may be diagnosed as *prepatellar bursitis*, and is either acute or chronic, serous, suppurative, villous, or plastic; in the last case it may assume the form of a globular, unyielding tumour, smooth and rounded externally, adherent to the skin, and movable over the patella.

If there is a rounded, tense, fluctuating swelling above the patella, but that bone does not "float," and there is no swelling on either side of the patella, or fluctuation across the joint from side to side, it is to be diagnosed as effusion into the *suprapatellar bursa*.

If there is no fluid in the knee-joint, but active extension of the joint is painful, and the ligamentum patellæ is prominent with a little swelling on either side of it, and fluctuation across from one side to the other, and especially if pressure upon the ligament causes some pain and a lateral bulging on each side of it, effusion into the *infrapatellar bursa* (or the bursa between the patellar ligament and the upper part of the tubercle of the tibia) may be diagnosed. The fat normally present around this bursa may give a sensation very closely simulating fluctuation, and therefore a comparison with the sound knee should be made with every care, and this diagnosis arrived at only when the condition is different on the two sides, and fluctuation is unequivocal.

If a fluid tumour is found on the inner side of the knee beneath the semimembranosus tendon, which becomes full and tense and projects back into the ham when the knee is extended, but is much less tense when the joint is bent, it is an effusion into the bursa between the semimembranosus and the gastrocnemius, sometimes called the *popliteal* or *semimembranosus bursa.* When the joint is bent the swelling will be plainly felt between the muscles; if the bursa communicates with the joint it is reducible on pressure.

A similar swelling over the inner condyle of the tibia, superficial to the semimembranosus tendon, becoming as it enlarges ovoid in shape with its long axis vertical, is an effusion into the *bursa under the sartorius.*

A small, tense, fluctuating swelling immediately above the head of the fibula, bulging backwards towards the ham, is an effusion into the *bursa under the biceps.*

In every case of pain in the knee the surgeon should satisfy himself that there is no disease of the hip-joint.

Ankle-joint.—The bones entering into this joint are so immediately subcutaneous that they can be readily and satisfactorily examined. It is necessary to point out the peculiarities of the swelling produced by effusion into the joint and into the tendinous sheaths and the bursæ around the joint, and also the peculiarities of the pain met with in these different affections. **Effusion into the joint** causes fullness in front of the joint beneath the extensor tendons, but particularly a rounded fluctuating swelling below and partly around each malleolus, giving an appearance of increased width to the joint which is very characteristic when seen from the back; there may be distinct fluctuation from one of these lateral swellings to the other.

Effusion into the sheath of the tibialis posticus tendon causes an elongated fluctuating swelling behind and below the inner malleolus reaching 2 in. or so above its tip, and extending downwards into the sole at the instep. The swelling is longer and reaches higher up than that caused by effusion into the ankle-joint, and is usually not accompanied by swelling around the outer malleolus. **Effusion into the peroneal sheath** causes a similar swelling behind the outer malleolus, and reaching down below it over the os calcis; this is not so common as the former. **Effusion into the bursa beneath the tendo Achillis (t. calcaneus)** causes a swelling above the point of the heel under the tendon, with fluctuation from side to side. Care must be taken in this observation, as the soft fat beneath the tendon may give a sensation which can be readily mistaken for fluctuation. On moving the joint, characteristic creaking and soft grating may be detected in these synovial sheaths and bursæ.

The **pain** of disease of the ankle-joint must be distinguished in the first place from that of disease of the tarsal joints, and then from that of disease of the synovial sheaths and bursæ. For this purpose the heel and instep should be grasped close to the ankle-joint and moved on the leg; if this elicits pain it excludes tarsal disease. If now, while the ankle is fixed, the foot is everted and inverted, the tibial and peroneal tendons being thus alternately put on the stretch, pain produced in either movement will indicate that one of these sheaths or one of the tarsal bones or joints is the seat of the mischief. The position of the swelling and of tenderness and the disclosures of the skiagram will clear up this point. In inflammation of the bursa behind the os calcis there is pain when the patient points his toes and contracts his calf muscles, and when the surgeon raises the toes and stretches the tendon of these muscles, but not when the toes are passively pointed.

For disease of the *temporo-mandibular joint*, see p. 390; of the *tarsal joints*, p. 716.

IV. ANKYLOSIS

When a patient presents a stiff joint the surgeon has to determine whether the ankylosis is due to bony union of the articular bones—*synostosis*, or *true ankylosis*—or to some other condition, either intra-articular or extra-articular, which limits or prevents the movement of one bone upon another —*false ankylosis*.

Nature of the ankylosis.—In some cases motion at the affected joint is at once obvious, and the following remarks apply only to those in which there is **apparent immobility** at a joint. (*a*) Notice whether there is pain during either active or passive attempts to move the joint; if there is, it indicates that the ankylosis is *false*. (*b*) Next notice the condition of the muscles which act upon the joint: if they are found spasmodically contracted, or if on attempting to move the joint they become tense, it shows that the ankylosis is *false*; great wasting and entire relaxation of the muscles is a useful sign of synostosis. A *skiagram* will show whether synostosis is present or not; it will also show the presence of nodular outgrowths of bone preventing movement, of changes in the articular surfaces indicating intra-articular disease or injury, or such perfectly healthy articular bones that the limitation of movement must be due to extra-articular disease.

To determine the **variety of the false ankylosis** is in many cases a more difficult matter. The history of the case should, of course, be carefully investigated, and the joint examined with a view to finding evidence of affection of the bones (enlargement or adherent cicatrices) or of the synovial membranes, or matting together of the tendons around the joint. The signs of old sinuses are important, as they usually, but not invariably, indicate intra-articular disease. If, then, the loss of mobility has followed upon a severe burn or destructive inflammation of the soft parts, or upon a fracture not extending to the joint; or if there is evident thickening of the soft parts, matting together, ossification or immobility of one or more tendons around the joint, and there is no deformity in the joint itself, nor enlargement of the bones. and the skiagram shows the bones to be unaltered, and if any movement that is possible is smooth and even, the adhesions are *extra-articular.* Where, on the other hand, there is a history of inflammation of the joint itself, or of wound or fracture extending into it; or the joint is deformed, the bones altered, and the soft parts marked with scars of old sinuses, the adhesions are *intra-articular.*

The diagnosis of the **nature of the disease** inducing the ankylosis presents no special points that require to be discussed here; the history of the case and the nature of the changes in the part will lead to a correct judgment. There are, however, some practical points in relation to some of the individual joints which require notice.

Ankylosis of the **lower jaw** is rarely *true;* its diagnosis is difficult, and may necessitate the administration of an anæsthetic or the obtaining of a good skiagram; it may depend upon cicatrices in the mouth or firm infiltration—bony or other—of the masseter muscle. (*See* p. 390.)

Ankylosis of the **shoulder** is very frequently *false,* and is very often *extra-articular.* Owing to the extreme mobility of the scapula, and the large share it takes in the angular movements of the arm, the patient, and even an incautious surgeon, may be misled as to the degree of stiffness present. To test the point, the surgeon should rotate the arm with one hand, while the other rests firmly on, and fixes, the scapula. As the scapula takes no share in this movement, any rotation that is possible must be at the humero-scapular joint ; the rotation must not be violent, especially when a joint has long been stiff, or it may cause fracture of the neck of the humerus.

Ankylosis of the **elbow** is more often *true*. Flexion and extension may be seriously limited by plastic material or bone filling up the coronoid or olecranon fossa, or by outgrowths from the coronoid or olecranon process ; the radio-ulnar joint participates in intra-articular ankylosis of the elbow. In cases of limitation of flexion of the joint at a right angle, be careful to ascertain that the head of the radius is not displaced forwards.

Ankylosis of the **wrist** is most frequently *extra-articular*, caused by adhesion of the tendons in their sheaths ; this is known by the accompanying limitation of the movements of the fingers and thumb —parts quite at a distance from the original injury or disease.

Ankylosis of the **digits** is most often due to *whitlow* and tendinous adhesions, or to *arthritis deformans.*

Ankylosis of the **hip** may be due to *osteo-arthritis*, but is more often the result of *septic* or of *tuberculous arthritis*. Synostosis without displacement or deformity of the bones is almost always the result of *septic* arthritis ; ankylosis with marked deformity of bone is as constantly the result of *tuberculosis*. Care must be taken to fix the pelvis by firm pressure while attempting passive or active movements, for where the joint is rigid the normal movement at the lumbar spine becomes increased. As in the shoulder, rotation movements are the most reliable.

In ankylosis of the **knee** the patella is the most convenient bone to examine for mobility; if it can be moved laterally to any degree it cannot be ossified to the femur, and this is strong evidence that the ankylosis between the tibia and femur is also false. Subluxation of the tibia backwards, or rotation of the bone outwards, or marked flexion of the joint, is strong evidence of *intra-articular* disease.

Ankylosis of the **ankle** is very often *extra-articular*, being frequently seen after fractures near the joint, or in bad sprains. When it is of long standing and complete, the tarsal joints become unusually mobile.

Ankylosis of the **tarsus** is most often *intra-articular* and *true*. It may exist on the outer side of the foot in connexion with old-standing talipes varus. In the joint of the great toe it is usually due to gout.

Ankylosis of the **spine and ribs** is considered at p. 399.

CHAPTER XXVI

DIAGNOSIS OF DISEASES OF THE HEAD

Chapter VII., in which the diagnosis of injuries of the head and of their sequelæ is discussed, should be read in connexion with this chapter. In it will be found information on cerebral localization, and on such affections as hæmatoma, hernia cerebri, and pulsating collections of fluid beneath the scalp. In this chapter are considered those affections of the scalp, vault of the skull, and cranial contents as are not traumatic in origin. The intracranial complications of middle-ear disease are dealt with in its concluding section.

Tumours of the Head

The first step in the diagnosis of a tumour of the head is to place it in one of three groups: (1) tumours of the scalp, (2) tumours of the skull, (3) intracranial tumours.

With the head fixed, gently grasp the swelling and notice whether it can be moved over the bone: if so, it is *extracranial*—a tumour of the scalp. Further proof will be afforded by a good *skiagram*, in which, in such a case, the dense shadow of the calvaria will be seen uninterrupted and distinct from the less opaque shadow of the tumour.

It is less easy to distinguish with certainty between cranial and intracranial swellings. Feel carefully for pulsation in the swelling; then determine whether it yields under gentle continuous pressure, and whether a strong expiratory effort, as in crying or coughing, causes it to fill out; examine for cerebral symptoms—irritative or paralytic—and, above all, examine carefully a good *skiagram.* Tumours of the *skull* are irreducible, incompressible, do not expand or give an impulse during a forced expiration, and are rarely pulsating; if they grow inwards as well as externally they may cause symptoms due to irritation or compression of the brain. In a skiagram the special features of the shadow of a cranial tumour are either that it is all superficial to the inner table of the skull, or that its deep margin is well defined and distinct from the brain. *Intracranial* tumours often protrude between growing centres of ossification, and their situation in the middle line or at a fontanelle is noteworthy. The pulsation of the cerebral contents is to be felt in them; when formed largely of the cerebro-spinal fluid they are more or less reducible on gentle pressure, and their tension is increased by forced expiration. There may or may not be cerebral symptoms, which vary as the tumour irritates, compresses, or destroys the cerebral tissues. The *skiagram* will show a deficiency in the cranium involving both tables of the skull.

TUMOURS OF THE SCALP

Having determined that a given swelling is in the tissues superficial to the bone and periosteum, its precise diagnosis may be arrived at as follows:

1. The colour will at once distinguish **cutaneous nævus.** When a soft tumour beneath healthy or nævoid skin is found to be compressible and to become fuller and tenser on the patient crying or

straining, it is a **subcutaneous venous nævus.** The patient is generally a child, and the swelling was noticed at or soon after birth.

2. If the tumour pulsates forcibly, is uneven on the surface, evidently consisting of convoluted vessels, through which the firm bone of the skull can be felt, and if large arteries can be traced in the scalp to the edge of the tumour, compression of which stops or lessens the pulse in the tumour, it is a **cirsoid aneurysm.** The skin over these tumours is usually hot. (*See also* p. 281.)

3. If the tumour is globular, tense, smooth, and fluctuating, irreducible and devoid of pulsation, it is a **cyst.** Four forms of cyst are known, only three of which can be diagnosed. If the tumour is acquired, adherent to the skin, and freely movable over the bone, it is a *sebaceous cyst.* This kind is often multiple, is commoner in middle and late life, and may attain a large size, and become inflamed and ulcerate. If the cyst has developed after an injury to the scalp it will probably prove to be an *implantation cyst*, and the bone may be found to be slightly indented beneath the cyst. If the scalp moves over the tumour, and if the latter is partially fixed to the bone, not freely movable over it, it is a *dermoid cyst.* Such cysts may be noticed at birth or may be only observed later on. They are most often found near the outer angle of the orbit. They are generally single. The bone beneath them may be thinned or even perforated. A *meningocele*, the pedicle of which has become occluded, could not be diagnosed with certainty from the above, unless it were tapped and found to contain clear serous fluid. If the tumour was of large size at birth, the surgeon should suspect meningocele and tap the tumour to clear up the diagnosis.

4. If the tumour is solid, movable over the cranium and under the scalp, and slightly lobulated in outline, it is a **subaponeurotic lipoma.** These tumours are usually of small size, and rather flattened in shape; they may become large and globular, and are then liable to be mistaken for tense sebaceous cysts. They are to be distinguished from cysts by the absence of fluctuation, by the slight lobulation of the surface, and by non-adhesion to the scalp. They are commonest in the frontal region, but may occur under any part of the scalp.

5. When the side of the head above the ear is swollen, hot, reddened, œdematous, acutely painful and tender, and tight closure of the jaws or wide opening of the mouth is painful, **abscess beneath the temporal fascia** is to be diagnosed. If the surgeon detects fluctuation the diagnosis is certain. A high temperature and polymorphonuclear leucocytosis will confirm the suspicion of abscess. The swelling is tense and boggy, and has the limits of the temporal fascia, not extending down on to the face or neck, but there may be œdema of the eyelids on the same side.

It is convenient to consider here the diagnosis of—

Ulcers of the Scalp

1. If at the base of the ulcer hard, dry, rough bone is felt and seen, the case is one of **necrosis.** When spontaneous the disease is syphilitic or tuberculous, and care must be taken to distinguish between these forms. If there are other signs of tertiary syphilis, especially gummata or deep ulcerations, or the scars of such, and there is a positive Wassermann reaction, it is **syphilitic osteo-myelitis.** The syphilitic form begins with headache, apparent thickening of the bone and scalp, and slow ulceration, and the dead

bone has a worm-eaten appearance; the ulceration is sinuous and often multiple. If, however, the ulcer has thin undermined edges, and discharges thin glairy pus in which tubercle bacilli can be found, it is **tuberculous osteo-myelitis.** This disease begins in a swelling which forms an abscess and bursts, discharging pus. The patient is usually young, thin, and delicate-looking; the Wassermann reaction is negative, and there are often other tuberculous foci.

The surgeon must be careful to distinguish mere exposure of the cranium from its necrosis. By wounds or cellulitis portions of bone are often exposed, but after a time the bone becomes pink in colour, and then gradually granulations sprout through its surface and the wound heals over. It is only when this does not take place, or the surgeon has evidence of the separation of a sequestrum in the formation of a groove around the exposed bone, that he must diagnose it as dead.

2. An ulcer of the scalp with thick everted edges and a dirty fungating or sloughy base, with a foul-smelling discharge, is either an ulcerated sebaceous cyst or an epithelioma. If on inquiring into the history of the case one finds that it began as a chronic globular lump which later on became inflamed and burst, and if the base of the ulcer moves over the bone and the associated lymphatic glands are not enlarged, it is an **ulcerated sebaceous cyst.**

3. But if, even with this history, the base of the ulcer has become adherent to the bone, or the glands at the angle of the jaw or behind the mastoid process or sterno-mastoid muscle are enlarged, it has developed into an **epithelioma.** In a doubtful case a portion of the edge of the ulcer should be excised and submitted to microscopic examination.

4. Where the ulcer began in a wart or crack or in a very chronic patch of lupus, has gradually extended, and its edge and base are adherent to the pericranium or bone, it is an **epithelioma.** The associated lymph-glands may be found enlarged.

5. A very chronic slowly-progressing ulcer with a thin rolled edge and smooth clean base, without enlargement of lymphatic glands, is a **rodent ulcer.** (*See also* p. 297.)

TUMOURS OF THE SKULL

1. If, in an infant, low, rounded, firm swellings of the bone are found grouped around the anterior fontanelle but not extending quite up to it, they are the "natiform swellings" of Parrot, and are due to **congenital syphilis**; the surgeon should examine carefully for other manifestations of inherited syphilis. If any part of the skull (not a fontanelle or suture) is found to yield under the finger, having the resistance of parchment rather than of bone, the condition is known as **craniotabes.** Such softened spots are usually found in the parietal bone behind the parietal eminence; they are generally associated with congenital syphilis, but may be due to rickets.

2. When, in later life, low, smooth, or uneven swellings of the bone are found, which are painful and tender, firm or fluctuating, they are to be diagnosed as **syphilitic nodes.** These vary much in their condition. In some the pain and tenderness are extreme. Some are hard and bony, others softer, and others again fluid. They may be single or multiple. Little pits in the bone may be felt between elevated ridges; in other cases the skin is ulcerated, and gummatous material or sequestra are exposed. They are associated with other evidence

of syphilis and are favourably influenced by anti-syphilitic treatment.

3. If the head is found flattened behind, with the forehead prominent, and the fontanelle widely open or open too late, and the bones are thickened along the sutures, it may be described as a **rickety skull.** The anterior fontanelle should not be palpable after the first year of life.

4. A prominent, clearly circumscribed tumour fixed to the bone, of absolute hardness, of very slow growth, and opaque to X-rays, its shadow in a skiagram being continuous with and as dense as that of the skull, is an **osteoma,** or ivory exostosis. If also intracranial, it may be accompanied by cerebral symptoms. Very rarely, after a period of many years such a tumour has become separated from the normal bone and cast off as a sequestrum.

5. A circumscribed tumour fixed to the skull, solid, firm, irreducible by pressure, and of steady growth, is to be diagnosed as a **malignant tumour** of the bone. The appearance of the tumour may be preceded by severe local pain; it grows with varying rapidity, and may exhibit pulsation either universally or in places only. Such tumours, which may be multiple, are usually secondary to carcinoma of the breast, prostate, or thyroid gland; examination will reveal the primary growth or evidence of an operation performed for its removal.

6. If an adult finds that he constantly has to get a larger hat, or by other signs a general increase in the size of the skull is verified, the affection will be recognized as **hypertrophy** of the skull. If at the same time, or subsequently, the long bones of the extremities become enlarged and curved, and the stature diminished, the disease is **osteitis deformans,** or Paget's disease. If, however, the mandible has

become prominent, and the hands and feet have enlarged, the "hypertrophy" of the skull is a part of **acromegaly.**

7. When the head of an infant or young child is found to be disproportionately large and continually increasing in size, with wide separation of the cranial bones and perhaps distinct fluctuation perceptible from suture to suture, it is a case of **hydrocephalus.**

INTRACRANIAL TUMOURS

1. If the tumour was noticed at or soon after birth, is soft, fluctuating, translucent, and yields under gentle pressure, and then becomes fuller and tense when the patient cries or strains, it is a **meningocele.** The bone may be seen or felt to be deficient at its base. These tumours are usually globular in shape; they are most often met with over the occipital protuberance, at the root of the nose, or along the middle line of the vertex. If they are tapped, cerebro-spinal fluid escapes. Meningocele is often associated with hydrocephalus.

2. If a congenital tumour with the general characters of a meningocele is found to pulsate synchronously with the temporal artery, it is known to contain some portion of the brain, and to be a **meningo-encephalocele.** In these cases pulsation may only be detected when the tumour is partially reduced. The movements of the brain with respiration may be detected, as well as arterial pulsation.

CEREBRAL TUMOURS

When a patient suffers from severe persistent headache, associated with irregular causeless vomiting, optic neuritis, and the gradual development of the signs of compression of the brain—a slow pulse, subnormal temperature, and loss of mental power—

and the symptoms have come on spontaneously, have developed gradually, and have resisted medicinal and dietetic treatment, the presence of a **cerebral tumour** may be diagnosed.

The patient must be examined for evidence of local destructive effects indicative of the exact position of the tumour. At present there are parts of the brain, especially the precentral convolutions, the functions of which are not clearly determined, and in these parts tumours may grow without giving rise to symptoms by which their exact seat can be determined. This "silent area" of the brain will no doubt soon be better understood, and then tumours will be localized there as certainly as in other parts. Advances are continually being made in our knowledge of cerebral localization, and the reader must refer to works on neurology for full information on this subject. The following statements we believe to be in accordance with present knowledge; they may be useful to students in localizing a cerebral tumour. The seat of pain does not correspond with the position of the tumour; vomiting is more severe in tumours below the tentorium; if optic neuritis is observed to come on earlier on one side, or is found more severe on one side, in the absence of definite paralysis, the tumour is to be regarded as on that side. Compression signs come on more rapidly in tumours of the cerebellum and base of the brain than in those in the cerebral hemispheres. The function of each of the cranial nerves must be carefully and systematically examined, and then the voluntary muscular power and the sensation of the whole body tested. If paralyses are found, a careful consideration of their distribution will guide to the localization of the tumour.

1. Motor paralysis of one limb or of one side of

the face, with convulsive attacks commencing in the paralysed part—Jacksonian epilepsy—and lessened acuteness of tactile sensibility in the paralysed member, point to the tumour being in the **motor cortical area** of the opposite side, i.e. the ascending frontal convolution, and the seat of the paralysis will indicate more precisely what part of this convolution is diseased. The centre for the leg is close to the longitudinal fissure (incisura interhemispherica), next below is that for the trunk, then lower down is placed the centre for the upper limb, and lowest down, reaching to the Sylvian fissure (sulcus lateralis), is the centre for the face.

2. If there is hemiplegia, together with hemianæsthesia and hemianopia, it points to the tumour involving the **internal capsule** of the side opposite to the paralysis. The loss of vision is in the temporal field of the eye of the same side as the tumour, and in the nasal field in the eye opposite to the tumour.

3. If, in addition to hemiplegia, hemianæsthesia, and hemianopia, there is special loss of control of the movements expressive of the emotions, and athetoid movements are observed, the tumour will probably be found to involve the **optic thalamus.** If the anæsthesia was noticed quite early in the course of the case it would confirm the diagnosis.

4. Hemiplegia and hemianæsthesia, with paralysis of the muscles supplied by the third nerve of the opposite side, indicate that the tumour involves the **crus cerebri (pedunculus cerebri)** on the side of the ocular paralysis.

5. Hemiplegia and hemianæsthesia, with facial palsy and deafness on the opposite side and conjugate deviation of the eyes towards the hemiplegic side indicate that the tumour is in the **pons.**

6. Paralysis of both sides of the body, with diffi-

culty in speech and deglutition, points to the tumour involving the **medulla oblongata.**

7. Blindness in the nasal part of each retina producing bitemporal hemianopia indicates that the tumour is pressing upon the optic chiasma, and that it is in the **pituitary gland (hypophysis).**

8. When the symptoms commence with deafness and noises in one ear, quickly followed by paralysis of the external rectus muscle and weakness of the facial muscles of the same side, and later on nystagmus, ataxy with a tendency to fall, and attacks of giddiness with a sensation of rotation of the body towards the deaf side, they show that the tumour is situated in **the angle between the pons and the cerebellum,** and is compressing the 8th, 6th, and 7th cranial nerves and the lateral lobe of the cerebellum. This type of tumour, in common with others below the tentorium cerebelli, causes early internal hydrocephalus from pressure on the iter. Hence the signs of compression, i.e. vomiting and optic neuritis, are severe and out of proportion to the size of the tumour. If the tumour extends far enough forwards it will cause pain in the area of distribution of the 5th nerve, while pressure upon the medulla oblongata will lead to weakness or paralysis of the opposite arm and leg.

9. If with early and well-marked optic neuritis, severe headache, and frequent vomiting are associated attacks of vertigo, nystagmus, unsteadiness of gait, and a weakness of one arm and leg, the symptoms indicate that the tumour is in the **cerebellum,** and on the same side as the more intense optic neuritis and the paresis of the limbs; the patient tends to fall as a rule towards the side on which the tumour is situated. The 6th nerve of the same side is often paralysed in these cases.

INTRACRANIAL COMPLICATIONS OF MIDDLE-EAR DISEASE

Leptomeningitis.
Extradural abscess.
Cerebral abscess.
Cerebellar abscess.
Serous meningitis.
Sinus thrombosis.
Acute and chronic labyrinthitis.

Intracranial complications are surgically the most important results of middle-ear disease. They are more common in connexion with chronic than with acute disease; they are infective in origin, and inflammatory in nature, and nearly always result from the direct extension of disease from the tympanum or mastoid antrum. More than one complication may be present at the same time. There is considerable variation in the symptoms produced, explained partly by differences in the extent and intensity of the disease, and partly by its localization. Exact preoperative diagnosis is often impossible, and the surgeon has then to eradicate the disease in the bone, and to follow up carefully any outlying foci of disease, and even to expose and explore those intracranial structures which in the particular case seem most liable to infection. The following symptoms should be investigated, and an examination of the cerebrospinal fluid obtained by lumbar puncture should be made; in many cases this will enable a correct diagnosis to be made.

1. **Pain.**—Headache is met with in all the complications we are considering. It is most intense in *leptomeningitis*; its seat affords no indication of the locality of an *abscess*. It may be entirely absent in *sinus thrombosis*.

2. **Hyperæsthesia.**—Intolerance of light, sound, and movement is met with in *leptomeningitis*, and is usually absent in *cerebral abscess* and in *thrombosis.*

3. **Cerebration.**—Slow cerebration, apathy, a long pause before a question is answered, with slowness of speech, is a frequent symptom of *abscess.* In *leptomeningitis* there is excitement passing on to delirium. In *sinus thrombosis* the mind remains clear.

4. **Temperature, pulse, and respiration.**—A persistent high temperature, especially if steadily rising, is characteristic of *leptomeningitis ;* a remittent temperature with successive abrupt rises and rigors followed by a fall to below the normal level, with sweating, is a prominent feature of infective *sinus thrombosis ;* a temperature that is persistently subnormal, or falls below normal every evening, or such a temperature with occasional slight rises above the normal, is met with in *abscess.* The *pulse* may be slow in abscess, but in many cases it is quickened ; in *leptomeningitis* it is always quickened—at first full and bounding, later on it is smaller and softer ; in *thrombosis* it becomes progressively faster and weaker. *Respiration* may be slow in *abscess ;* Cheyne-Stokes rhythm indicates involvement of the medulla, either by the compression of a *cerebellar abscess* or by basal *meningitis.*

5. **Giddiness** is most severe in *acute labyrinthitis :* it is also met with in most cases of *cerebellar abscess*, and may be present in *sinus thrombosis.* If the patient is up, it may cause staggering and a fall : when in bed, it may make him habitually lie on the side opposite to the abscess.

6. **Vomiting** is a frequent symptom in *leptomeningitis*, often occurs in *cerebral abscess*, and is very urgent in *cerebellar abscess.*

7. **Optic neuritis.**—In *sinus thrombosis* there may

be venous congestion of the discs only, but frequently optic neuritis is marked; hyperæmia may be met with in *leptomeningitis*; optic neuritis is most often seen in cases of *abscess*, especially cerebellar abscess; if asymmetrical it is usually more intense on the side of the abscess. It may be absent.

8. **Convulsions** are particularly associated with *leptomeningitis*; they occasionally occur in cases of *cerebral abscess* on the side opposite to the abscess. Conjugate deviation of the eyes to the side opposite to a *cerebellar abscess* is often seen.

9. **Paralysis.**—Hemiplegia often comes on quickly from *leptomeningitis*. Slight paresis of the opposite side of the face, and perhaps of the opposite arm too, is met with in *temporo-sphenoidal abscess*.

10. **Aphasia.**—Motor aphasia and word-deafness are signs of an *abscess* in the *left temporo-sphenoidal* lobe; word-blindness may be caused by *cerebellar abscess*.

11. **Deafness.**—An abscess in the temporo-sphenoidal lobe may paralyse or destroy the auditory centre of the opposite ear. Entire deafness coming on in a previously sound, good ear, without signs of middle-ear disease on that side, is therefore an important but rare sign of *temporo-sphenoidal abscess* in connexion with chronic disease in the opposite ear.

12. **Constipation, etc.**—Foul breath and obstinate constipation are common to all. Rapid wasting may occur in *cerebral abscess*, but is especially marked in *sinus thrombosis*.

13. **Caloric and rotatory tests.**—In cases of apparent recovery from acute labyrinthitis, the necessity arises for the employment of these special tests (*see* below).

There are no symptoms which enable us to diagnose with any certainty the presence of **pachymeningitis.**

When a patient with chronic otitis media is suddenly taken ill with intense headache, high fever, mental excitement or delirium, intolerance of light and sound, rapid pulse, furred tongue, and foul breath, there is **leptomeningitis.** The cerebrospinal fluid is turbid and cytological examination shows a high content of polymorphonuclear leucocytes or pus cells. Convulsions or hemiplegia would confirm the diagnosis ; coma usually quickly supervenes.

When the patient has persistent fever, and there is localized pain, and perhaps definite tenderness at one point on the bone to sharp percussion, an **extradural abscess** is to be suspected. The pus may be found between the tegmen tympani and the dura, or around the lateral sinus.

When a patient with chronic otitis media becomes dull and apathetic, with slow cerebration, and the temperature is found subnormal either persistently or at some time of the day, and there are vomiting, giddiness, headache, and optic neuritis, there is strong reason to diagnose **abscess** in the brain. The pulse is usually slow in the earlier stages of abscess, but becomes rapid later on.

If there is weakness (or paralysis) of one side of the face and of one arm, and the patient is found to lie with the paretic cheek and arm uppermost, the abscess is in the *temporo-sphenoidal lobe* on the side opposite to the paresis, or on the same side as the diseased ear if only one is affected. Aphasia would be a valuable sign of a left-sided abscess. Recent total deafness in an apparently healthy ear would strongly support the diagnosis of abscess in the opposite *temporo-sphenoidal lobe.*

But if there is no paralysis of face or arm, and the patient is very giddy, always lies with the diseased ear uppermost, vomits often, and the eyes are turned to the side on which he lies, the abscess is in the *cerebellum.* There may be word-blindness, intense optic neuritis, and deafness to the tuning-fork on the side of the abscess to confirm this diagnosis. The abscess is on the side opposite to that on which the patient habitually lies and towards which his eyes are turned, and is on the same side as the optic neuritis appeared first, and is more intense. The knee-jerk may be exaggerated on the side of the abscess, and in rare cases there is weakness of the arm and leg on the side of the abscess owing to the cerebellum bulging into the foramen magnum.

When the patient exhibits the signs and symptoms of any of the above conditions, but the cerebro-spinal fluid is clear, and the condition completely subsides after free opening and drainage of the mastoid region, it is a case of **serous meningitis.** This complication can only be diagnosed by the result of the above treatment, so closely does it mimic a true spread of infection to the interior of the cranium.

When a patient with chronic otitis media becomes ill, apathetic, febrile, with a rigor and sudden sharp rise of temperature, and the pulse becomes rapid, and there is localized tenderness to sharp percussion over the lateral sinus and increasing weakness and wasting, **sinus thrombosis** must be diagnosed, and the lateral sinus explored without delay. Repetition of the rigors, signs of infection of the lungs and of general pyæmia, would confirm this diagnosis. If the internal jugular vein is felt as a firm cord in the upper part of the neck, or the mastoid vein can be felt thrombosed, it would point to thrombosis of the *lateral sinus.* Œdema of the eyelids and conjunctiva, proptosis, and great venous engorgement of the optic disc would point to involvement of the *cavernous sinus.*

In the absence of accompanying meningitis there is no change in the cerebro-spinal fluid in either sinus thrombosis or abscess

When a patient with chronic or acute otitis media is suddenly seized with intense vertigo and ataxia, and there is nystagmus with the rapid movement towards the sound side, increased by voluntary movement of the eyes in this direction, **acute labyrinthitis** is to be diagnosed. There may be vomiting at the onset, and pain either in the ear, at the occiput, or on the top of the head. Any hearing previously present in the diseased ear is completely lost.

When a patient has exhibited the above signs, and after one or two weeks the ataxy, vertigo, and nystagmus have all cleared up, a careful examination must be made of vestibular function on the affected side. A negative caloric test, i.e. failure to produce nystagmus to the sound side on irrigating the ear with cold water, and to the affected side with hot water, together with a shortening of the duration of " after-nystagmus " in the direction of the diseased side when the rotation test is employed, indicates destruction of the vestibular function, and compels the diagnosis of **chronic labyrinthitis.**

CHAPTER XXVII

DIAGNOSIS OF DISEASES OF THE GUMS AND JAWS

DISEASES OF THE GUMS

A HEALTHY gum is of a uniform bright-pink colour, with a crenated edge, firm, smooth, and adherent to the necks of the teeth. The evidences of disease are alteration in colour, especially along the free edge, alteration in texture, loss of smoothness, separation from the teeth, recession, escape of pus either from a sinus or around the neck of one or more of the teeth, ulceration, a general swelling or a localized enlargement.

The gums are swollen, spongy, and livid in **scurvy**; they may show petechiæ, bleed easily, and the teeth become loose or fall out. If the gums are swollen, and the edge surrounding the necks of the teeth is sloughy and separated from the teeth, inquire as to whether the patient has been taking mercury, or is exposed to the influence of this metal in any way; where that is so the affection will be recognized as **mercurial gingivitis**; there will also be swelling and perhaps ulceration of the tongue, salivation, loosening of the teeth, a metallic taste in the mouth, and marked fetor of the breath. Where, however, there is no mercurialism, and aphthous sores are found on the lips or tongue, the condition will be recognized as **aphthous gingivitis.**

Where the gum is slightly separated from the teeth, and from between them a little pus can be seen to ooze up, especially when pressure is made with the finger upon the part, the disease is **pyorrhœa alveolaris.** This is now known to be a very important disease. Its earliest sign is a deep-red line along the free edge of the gum, with loss of its crenated edge. It begins most often in the incisor region or round a stump, and once started is liable to spread widely until it involves all the gum. It causes a disagreeable odour of the breath and a foul taste in the mouth, especially on waking. When it is severe the patient may eject from the mouth a considerable quantity of odorous sero-purulent fluid, and this may dribble from his mouth during sleep and leave a pink stain on the pillow.

A **sinus** in the gum should be carefully probed, and the adjacent teeth explored, and if the probe leads down to a hard smooth surface it is probably the fang of a tooth. The probe may, however, pass over a more extensive surface of sequestrum, **necrosis of the alveolar process.** The skilled hand can distinguish the sensations given when a probe touches the crown of a tooth, a fang, or bone. As teeth are more opaque to X-rays than is bone, a skiagram will show a tooth or a fang buried in the jaw, and may prove very helpful in diagnosis. If, on looking into the mouth, the surgeon finds the gum receded from the teeth, and the teeth loose or fallen out, and if the alveolar process is bare and exposed, with pus welling up alongside it, he will diagnose **necrosis.** This may have resulted from injury in tooth extraction, with supervening pyogenic infection (*traumatic*), or have followed one of the exanthemata (*exanthematic*), in which case it affects the alveolar process only, is often symmetrical, and is insidious in its progress;

or it may occur in one exposed to the fumes of yellow *phosphorus*, when the necrosis is apt to involve the whole depth of the bone, and to be accompanied by a great amount of swelling, and in the case of the lower jaw by the formation of a shell of new bone around the sequestrum. A sequestrum due to phosphorus poisoning is nearly always rough on the surface, and of a dirty brownish colour. Necrosis of the jaws is also seen as the result of *cancrum oris*.

The remaining affections of the gums may be grouped together as **tumours.** The rapidity of growth, attachment, consistence, and tendency to ulcerate are the facts to be particularly observed in such cases.

When in an infant or young person the gum is found growing up and overlapping the teeth, or even burying them entirely, and projecting in the mouth as irregular lobed masses of firm tissue covered by healthy mucous membrane, it is a case of *hypertrophy* of the gum. This is a congenital affection, though it may not be recognized until some time after birth; it may be associated with hypertrophy of the alveolar process and premature eruption of the teeth. A similar condition may be met with in middle life, and is then often associated with buried stumps of teeth.

If there is a small pedunculated growth from the gum attached between two teeth, and covered with healthy mucous membrane, it is a *polypus* of the gum. If the growth is papillated or villous on the surface, it is known as a *wart*. Similar warts are sometimes seen on the palate or on the tongue.

A soft purple mass, readily bleeding, with an uneven surface, growing from an alveolus, is a *granuloma*. It indicates the presence within the alveolus of an infected root of a tooth.

If a sessile tumour grows from the gum, being firmly fixed to the alveolus, and is of slow growth. very firm, painless, and covered by healthy mucous membrane, it is a *fibrous epulis*. When it is of large size the surface may ulcerate from pressure and friction. This is to be distinguished from a polyp by its deeper and broader attachment, and usually by its greater size.

But if the tumour is quite sessile, firmly fixed to the alveolar process, has grown more rapidly, and especially if it has a livid colour, a lobed surface, and soft consistence, and is found to spring from within the alveolus, and in its growth to expand the alveolus and loosen the teeth; it is a *myeloid epulis*.

When the gum is found to be the seat of a steadily spreading ulcer, with an indurated base and everted edge, the condition is *epithelioma*. Enlargement of the lymphatic glands will confirm this diagnosis. In case of doubt a piece of the growing edge should be cut out and examined microscopically.

A very chronic solid enlargement of an alveolus is probably caused by an *odontome* in connexion with the fang of a tooth. Several pathological varieties of odontomata are described, depending upon the particular element of the embryonic tooth involved. (*See* p. 389.)

DISEASES OF THE JAWS

The **acute affections of the jaws** are inflammatory, and the most frequent is **alveolar abscess.** Whenever, therefore, a patient presents himself with an acute, painful, and evidently inflammatory swelling of the face, over either jawbone, the first thing for the surgeon to do is to seek for evidence of alveolar abscess. By gentle pressure let him find the seat of most acute tenderness, and observe whether the swelling is fixed to the bone; next he should examine the teeth, looking first of all for carious stumps and for pus escaping by an alveolus; and then he should tap each tooth in succession with some small metal instrument to detect whether any one of them is tender to sharp vertical pressure. Passing his finger between the lip and the gum, he will feel for swelling over the alveoli. If he finds the swelling fixed to bone, and one tooth very tender to pressure, probably also decayed, with swelling over its alveolus, he will diagnose alveola abscess. It may point at some distance from the diseased tooth which gives rise to it.

When, however, the swelling is very extensive, especially if it involves the body and ramus of the lower jaw, and there is no evidence of its connexion with an individual tooth; or several teeth are found loosened, raised from their sockets, and very tender, it must be diagnosed as **acute osteo-periostitis.** There is generally high fever in this condition.

When a patient with an alveolar abscess or any similar infective condition of the jaws develops double proptosis with congestion and œdema of the conjunctiva, and immobility of the eyeballs with fixed dilated pupils, there is **thrombosis of the cavernous sinus.** Examination of the fundus will show engorgement of the retinal veins.

An acutely inflamed gland below the lower jaw may closely simulate either alveolar abscess or acute periostitis, but it will be found to be movable over the bone, if one finger is placed on the floor of the mouth, and fingers of the other hand on the swelling outside.

If a patient is febrile and complains of pain or a sense of fullness in one side of the face, examine the antrum carefully. Note any swelling or tenderness of the cheek, any congestion of the outer wall of the nasal fossa, any discharge from the nose, and compare the translucency of the two maxillæ when a small electric light is held in the mouth, i.e. by transillumination. If one maxilla is opaque and pus is seen in the nose under the middle turbinate bone, there is certainly **acute suppuration in the antrum (sinus maxillaris).** In cases where the signs are not conclusive an exploratory puncture into the antrum should be made through the front of the outer wall of the inferior meatus.

The **chronic affections of the jaws** include necrosis, periostitis, effusion into the antrum, cysts, and solid tumours.

A chronic sinus over either jaw, whether opening in the mouth, or on the face, and even in the neck, is usually caused by **necrosis** either of tooth, odontome, or bone. It should be carefully probed, and the fact of bare tooth or bone determined. A good skiagram will show the position of the sequestrum, dead tooth, or tumour.

The surgeon must bear in mind that a sinus in connexion with a *dead tooth* may open at some distance from it, on the face, the neck, the palate, or into the nose. In all cases of sinuses in these situations, therefore, the teeth must be carefully examined for caries, and a buried fang must be sought for. When there is great thickening around the jaw, or the probe leads to the bare ramus or body of the lower jaw, or a large sequestrum is seen in the mouth, the condition is *maxillary necrosis.* The most extensive variety of this is *phosphorus necrosis.*

In examining any **swelling** or **tumour of the jaws,** notice particularly its extent, its outline, its consistence, its effect upon the bone and the teeth, and the occurrence of hæmorrhage or discharge. Cysts are frequently met with in the jaws; they usually have a globular outline, and in their growth expand the bone over them, and thus a sensation of egg-shell crackling or of the buckling of parchment may be felt on pressing on them. The teeth must be examined not only to see if they have been displaced or loosened by the growing tumour, but also to notice whether one or more is unerupted, shown both by its absence from the alveolus and by its shadow in a skiagram. Hæmorrhage occurs particularly from malignant growths; muco-pus and pus may flow in large quantities from the nose in empyema of the antrum.

In the upper jaw the relation of a tumour to the **antrum (sinus maxillaris)** is a matter of particular interest. To examine the antrum, first observe the contour of its walls, then compare the translucency of the two cavities by placing a small electric light in the mouth, and finally, if necessary, open the cavity and examine its contents. When these are fluid a puncture may be conveniently made through the alveolus of a tooth, preferably the first or second molar, or through the outer wall of the inferior meatus of the nose; when solid, a larger opening should be made through the canine fossa. Distension of this cavity may cause a bulging of its outer wall below the orbit and malar bone, a flattening or depression of the roof of the mouth, a raising of the floor of the orbit, causing protrusion of the eyeball and, when extreme, blindness, and obstruction in the nasal fossa of the same side with epiphora. Expansion of the cavity is not always uniform; it may occur especially in one direction, but it must not be diagnosed unless more than one of the antral walls is found to be bulging. Distension of the antrum may be caused by the growth of cysts into the cavity, and especially by solid tumours, bony, sarcomatous, or cancerous.

In the case of **large tumours** the surgeon must endeavour to ascertain whether the tumour is limited to the jaw or involves other bones; he should examine the temporal region, the nose, and the bone over the frontal sinuses for evidence of swelling, and then, passing his finger behind the soft palate, should feel whether the tumour is filling up the pharynx, or is fixed to the base of the skull.

When the surgeon recognizes that he has to deal with a tumour of the jaw he should first decide whether it is inflammatory in nature. If the swelling is on one side of the bone only (as on the hard palate, or outer side of the lower jaw), and if it is painful and somewhat tender, it must be considered as **chronic periostitis.** If such a swelling is found to fluctuate it is a **chronic alveolar abscess.** If the swelling subsides under treatment the diagnosis will be confirmed; if it withstands treatment and continues to enlarge without forming an abscess, and particularly if it bleeds, it is a **neoplasm.**

A smooth globular or ovoid tumour, which has grown slowly and painlessly, in a young person, is almost certainly a **cyst**; and if to these signs there is added fluctuation or "crackling," the diagnosis is certain.

If the cyst is single and the permanent teeth are normally erupted, it is a *dental cyst*; the presence of a carious fang close to the swelling supports this diagnosis. If, however, the cyst is single, has grown slowly in a young person, and one of the permanent teeth is unerupted, it must be diagnosed as a *dentigerous cyst* or *follicular odontome.* Finding the tooth in the cyst, or seeing it in the skiagram, will conclusively prove the correctness of the diagnosis.

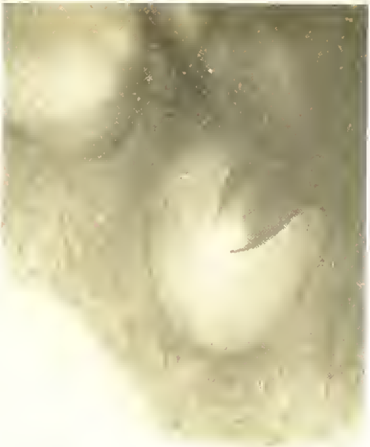


Fig. 1. -Dentigerous cyst.

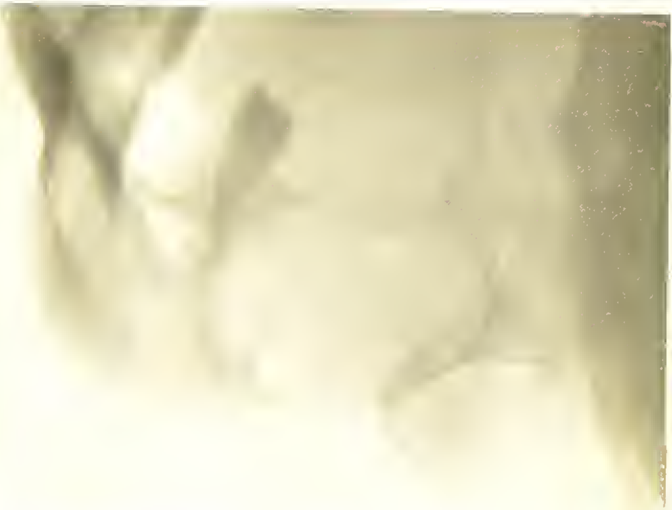


Fig. 2. - Dental cyst.

PLATE XIV.

Dentigerous cysts are commoner in the lower jaw and around an unerupted third molar. If, however, the cystic tumour is lobulated and more irregular in outline, and of very slow growth, it is to be diagnosed as a *multilocular cyst* or *epithelial odontome*. These cysts are usually met with in young persons, and are commoner in the lower jaw. (Plate XIV.)

Solid tumours are to be distinguished from each other by the same rules as in other situations. (*See* Chaps. XVIII. and XXIV.) A circumscribed hard tumour, as opaque to X-rays as the jaw itself, is an **osteoma**. If such a tumour is found in the alveolus, and is seen to be even more opaque to X-rays than is the bone, and to have a nodular outline, it is an **odontome**.

When one or other jawbone, or any of the other facial bones, slowly and progressively enlarges, forming large nodular masses of bone without distinct circumscription, and being quite unmodified by treatment of any kind, the disease is known as **leontiasis**. The swelling is as a rule symmetrical. When advanced, this disease causes great distortion of the features.

A tumour of rapid continuous growth which infiltrates and distorts the jaw, displaces and loosens eeth, and extends into the neighbouring cavities, ossæ, or soft tissues, is easily recognized as malignant. If the lymphatic glands beneath the mandible nd along the carotid vessels are enlarged, it is a **arcinoma**; where the tumour is large and there is no nvasion of glands, it is a **sarcoma**. In the early tages it is impossible to distinguish between these rowths except by microscopical examination.

If the patient complains of a dull aching pain n the face and of an unpleasant odour in the nostril f the same side, and has a bad taste in the mouth in the morning, and if, when he lies down on the opposite side, or holds his head down, odourless pus streams from the nostril, and the antrum is found opaque, it is easy to diagnose **empyema of the antrum** (sinus maxillaris). More often, however, the symptoms of this disease are obscure—slight local discomfort, irregular discharge from one nostril, recurrent attacks of naso-pharyngitis, and chronic ill-health—and the diagnosis is only established by the opacity of the antrum and the results of an exploratory puncture.

THE TEMPORO-MANDIBULAR JOINT

Pain and inability to open the mouth properly are the two leading symptoms of affections of this joint. They may be produced by acute inflammation of the joint itself or of neighbouring parts which are pressed upon or stretched by the moving mandible, by osteo-arthritis, by spasm of the muscles of mastication, by fibrous or bony adhesions in the joint, by cicatricial contraction around the joint, and by tumours near the joint. To arrive at a diagnosis, first ascertain whether the trismus is recent and acute, or of long standing.

Acute trismus.—If acute, examine for swelling of the joint itself immediately in front of the tragus, and for swelling of the parotid gland, or tonsil, or in the temporal fossa, jaw, face, and upper parts of the neck. Then notice whether the masseter muscle is rigid, or becomes rigid on any attempt to open the mouth, and if there is any spasm or rigidity of the muscles elsewhere, especially in the neck and spine.

1. If the joint itself is swollen, tender, and any slight movement in it is painful, it is a case of **acute arthritis**; this often ends in suppuration, and the

pus is discharged either into the auditory meatus, the mouth, or behind the ramus of the jaw. The disease may lead to necrosis of the condyle of the jaw or to ankylosis of the joint. This joint is not infrequently the site of a pyæmic arthritis. It is also frequently one of those involved in acute polyarticular osteo-arthritis.

2. If there is a painful, tender swelling near the joint, the cause of the trismus is evident; common examples are afforded by mumps, tonsillitis, temporal abscess, alveolar abscess, acute lymphadenitis.

3. If there is no local swelling, but the muscles closing the jaw are felt to be rigid and are the seat of severe painful spasms, it is a case of **tetanus**; the extension of the spasm to the muscles of the trunk will confirm the diagnosis. (*See* p. 30.)

4. If there is no local swelling, and the jaws are held closed by rigid muscles, but there are no painful spasms and the muscles of the neck and trunk are not involved, it is a case of **reflex trismus.** The cause of the trouble will usually be found in a carious tooth or an imperfectly erupted wisdom-tooth.

Chronic trismus.—The existence of a *tumour* in the parotid or submaxillary region or in the mouth or pharynx, preventing opening of the jaws, is readily recognized. The finger in the mouth can easily detect firm cicatricial bands causing *cicatricial trismus.*

1. When the movement of the jaw is attended with pain and a sense of grating in the joint, which in many cases is perceived by the surgeon, and the condyle is felt to be enlarged, there is **osteo-arthritis.**

2. When the movement of the joint is very limited, and there is neither tumour nor fibrous band nor rigid muscle to account for it, there is **fibrous ankylosis.**

3. When the joint is immovable, and there is no cause for this outside the joint, the condition is one of **true** or **bony ankylosis.** A skiagram will show the synostosis. A scar may mark the seat of an abscess from suppuration in the joint, or a wound which has caused fracture involving the joint. If this occurs in children it leads to considerable deformity from imperfect development of the bones. The ankylosis may be unilateral or bilateral.

4. Movement of this joint is sometimes attended with a sudden and painful slip or catch, due to a slight **displacement of the interarticular fibro-cartilage.**

CHAPTER XXVIII

DIAGNOSIS OF DISEASES OF THE SPINE

A SURGICAL examination of the spine should include investigation of the following seven points:

1. The state of the coverings of the spine, including the features of any tumour over it.
2. The curves of the spinal column.
3. The mobility of the vertebræ.
4. The condition of the spinal muscles.
5. The sensitiveness of the spine.
6. The condition of the vertebræ, as shown in a skiagram.
7. The evidence, if any, of pressure upon the spinal nerves or spinal cord.

Where possible the patient should stand in a good light with heels together, arms hanging, and eyes directed straight forwards. An infant should be examined in the sitting posture. In all cases alike a couch or a bed should be at hand for the examination of the body in the prone and in the supine position.

1. **The coverings of the spine.**—Notice the condition of the skin, particularly the presence of hyperæmia or pigmentation, of ulceration or sloughing, of a dimple, sinus or fistula, of an abnormal growth of hair, or of a tumour or swelling over the spine. Redness, ulceration, and sloughing are usually the result of pressure from prolonged recumbency

with neglect, the wearing of an ill-fitting instrument, or the projection of an unduly prominent spine. Dimples, median sinuses, and fistulous communications with the spinal cord or its membranes are met with in congenital malformations. Use a probe to find out the direction and length of a sinus, and by the microscope and chemical tests determine the nature of any discharge, whether pus or cerebrospinal fluid. A growth of hair over the lumbar spine is often met with where the underlying spinous processes are defective—spina bifida occulta. For the diagnosis of tumours over the spine, *see* p. 408.

2. **The curves of the spine.**—The surgeon should first observe the natural antero-posterior curves of the spine, noting whether they are increased or diminished, replaced by a general curve of the spine backwards, or interrupted by an abrupt projection of one or more spines. He should next determine whether there is any rotation of the vertebræ one upon another. For this purpose the prominence of the angles of the ribs, and of the lumbar transverse processes on the two sides, must be carefully compared. The height and prominence of the scapulæ, the hollow of the waist on each side, and the apparent prominence of the iliac crests must be noted. To determine the symmetry of the spine more accurately the patient should stoop forwards while keeping the knees straight; in this position the angles of the ribs are uncovered by the scapulæ, and the lumbar transverse processes project backwards, and the surgeon, standing behind the patient, or looking down along his back, can see at once if the transverse processes of the vertebræ are on the same level on the two sides. The diagnosis of scoliosis must depend upon the presence, and degree, of rotation of the vertebræ, as shown by the

unsymmetrical projection of the transverse processes and angles of the ribs, and not upon the lateral deviation of the tips of the spinous processes. Then, turning the patient round, the surgeon should notice whether one breast is more prominent than the other, or either side of the chest is flattened, and if the two anterior iliac spines are on the same level, or one is lower and more prominent than the other. Having made this examination, carefully trace the tips of the spines from above downwards to notice whether they are all present and in line, or whether one or more is absent or deflected to one or other side; a convenient way of doing this is to place an ink mark on the skin over each spine-tip and then connect the dots by a continuous line.

A general rounded curve of the spine backwards is due to debility or to posture; an abrupt posterior curve is caused either by congenital absence of a vertebral body or by destruction of the anterior part of one or more vertebræ. An exaggeration of the lumbar curve—lordosis—is to compensate either for kyphosis above, or for tilting forwards of the pelvis as in fixed flexion of the hip or in congenital dislocation of the hip. It also occurs in obesity or when a large abdominal tumour is present. A lessening of the lumbar curve is seen in early lumbar caries.

Lateral deviation of the spine is caused in a few cases by congenital absence of one-half of a vertebral body, but more often by faulty posture, by tilting of the pelvis to compensate for inequality in the length of the lower limbs, or for abduction or adduction of one thigh, or by retraction of one side of the chest, or in conditions of general bone-softening.

3. **The movements of the spine.**—The surgeon should first of all observe *the patient's movements*,

encouraging him to walk, run, or pick things up from the floor, etc., and notice whether these actions are performed easily and without restraint, or whether he keeps the spine rigid, and moves the hips and knees instead, or rotates the trunk on the thighs instead of turning the head from side to side. The several parts of the spine can be examined by placing the hand flat on the back and getting the patient to bend and extend the region, noticing whether the vertebræ move one upon another, or are immovably fixed. In the cervical spine the movements of nodding the head, rotation of the head, and flexion of the spine should be separately investigated, as they occur at separate joints. Thus, if nodding the head is free and painless, the occipito-atloid joint is unaffected; if the face can be turned without difficulty from side to side, the atlo-axoid joint is free; and if flexion of the head is quite free and painless, the lower cervical spine is unaffected: any one of these movements may be impossible, or very limited and painful, and this will point to disease of one or other of these regions. In all cases of alteration in the curves of the spine it is important to discover whether the deformity can be corrected or not, and whether the change in form is accompanied or not by a loss of the natural mobility of the vertebræ. Limitation of mobility of the spine may be caused by spasm of the spinal muscles, by changes in or ankylosis of the spinal articulations, by deformity or by synostosis of the vertebral bodies, or by extra-spinal conditions which interfere with the movements of the trunk, such as thoracic and abdominal tumours. The fact that the movements of the spine are quite unrestricted and unaltered is strong evidence of the absence of serious disease in the spinal column.

4. **The condition of the spinal muscles.**—Notice whether these muscles are weak, or wasted, or rigid. Get the patient to bend forwards, and, with the hand on his head or nape of his neck, observe how much resistance to extension of the spine his muscles can overcome: the strength of the extensor muscles of the spine can be thus tested. Feel the muscular mass on each side of the lumbar spines and judge whether it is wasted or unduly rigid. The best way of testing for muscular rigidity, however, is to notice the ease and freedom, or the reverse, with which the various movements of the spine are made. The head may be supported in the hands to prevent any movement in the cervical spine; in stooping to the ground the patient may only flex his hips and knees and further steady the spine by resting his hands on his thighs, while similarly all the turning or lateral bending movements of the trunk are made at the hip-joints. Spinal muscular rigidity is due either to some condition in which movement of the vertebræ is painful (caries, osteo-arthritis), or to ossification of the muscles (myositis ossificans), or to lumbago. Extreme wasting of the muscles is seen especially in anterior poliomyelitis, and when from any cause patients have been recumbent for a very long time. Weakness of spinal muscles is seen as a part of general debility, as in rickets, convalescence from acute illness, and in overgrown and ill-trained adolescents.

5. The **sensitiveness of the spine** should be tested in four ways: (1) Press with the fingers over the spinous processes. If the patient flinches and shows signs of pain, the surgeon should notice whether touching the skin very lightly or pinching it up without any pressure on the bone is equally painful, whether the patient moves the apparently

tender part of the spine in flinching away from the finger, and also whether, when attention is diverted, pressure on the same spot is tolerated. These signs indicate cutaneous hyperæsthesia, which is an important sign of "*hysterical spine.*" Patients with active inflammation of the bodies of the vertebræ can usually bear firm pressure over the spinous processes. The sensibility of the skin to heat and cold may be tested, but this is of no value in determining the condition of the bones. (2) Press vertically down through the spine to see if there is any hypersensitiveness of the bodies of the vertebræ —a very frequent effect of disease of these bones. The patient may be standing or sitting, the surgeon standing facing him and ready to notice the least expression of pain. Pressure is best made upon the head; at first it should be quite light, but if this fails to elicit pain it may be gradually increased up to heavy pressure, and, if this is borne without any evidence of pain, undue sensitiveness of the bodies of the vertebræ is excluded. (3) Make firm pressure alternately on the two transverse processes of a vertebra, so as to rotate the bone slightly; where the joint between two bones is diseased, this movement is painful and is resented. (4) Ask the patient to make some movement which would cause a jar up the spinal column, such as to jump down off a chair or to run downstairs. If instead of doing this freely he refuses to do it, or only does it slowly and with special precaution to avoid or to lessen the spinal jar—holding on to the chair and only letting himself down with great care and very slowly—it equally shows the presence of undue sensitiveness of some part through which the jar would pass.

6. The **condition of the spinal bones and**

joints can be determined by carefully feeling the spines to ascertain that none of them is absent or bifid, by noticing any grave deformity of the spine, such as an abrupt kyphosis, which can only occur when there is congenital absence of or acquired destruction of the corresponding vertebral body or bodies, and by examining a *skiagram* of the spine. This is the most accurate method, for it shows changes in the bones unassociated with deformity, and also joint changes which cannot be felt. In examining the skiagram, look first of all at the neural arches (arcus vertebræ) and their processes, to make sure that they are intact and symmetrical. Then examine the bodies of the vertebræ, and notice any faintness of shadow or loss of distinctness in the structure of the bone, pointing to early tuberculosis; or destruction of the bone, as in advanced tuberculosis; or synostosis, as in healed tuberculosis or in osteo-arthritis. Lastly, note any replacement of the bone by a tissue of different opacity to X-rays and without the structure of bone, as an aneurysm, an abscess, or a new growth.

7. **Nerve phenomena.**—The symptoms to be investigated are pain, hyperæsthesia, anæsthesia, muscular spasm or paralysis, and the condition of the reflexes. The exact extent of sensory alterations, and the muscles affected, should be carefully determined. The diagnostic importance of these symptoms is that they enable us to judge whether there is an organic lesion of the nervous system, the position of such a lesion, and whether it has an irritative or a destructive effect.

An extensor reflex of the great toe when the sole of the foot is stimulated—Babinski's sign—is conclusive evidence of a lesion of the pyramidal tract (fasciculus cerebro-spinalis); it is never produced by a "neurosis." A true clonus in the ankle, where the movements of the foot increase with increased flexion of the ankle-joint, is another sign of organic lesion; in a "neurosis" clonus is often observed, but it is arrested by firmer flexion of the ankle, and so is distinguished as "false clonus." An increased knee-jerk is a very common symptom in a "neurosis"; it is met with also in any disease interfering with the function of the upper motor neuron. The knee-jerk is lessened or lost in any organic lesion involving either afferent or efferent nerves, or the reflex centre; it is entirely lost below a lesion which nearly or wholly destroys the conductivity of the spinal cord.

Limitation of nerve disturbance to the area of distribution of a nerve or nerves indicates that the causative lesion affects the nerve-trunk or trunks and not the spinal cord. As nerve-trunks, composed of medullated nerve-fibres, are much more resistant to the effects of pressure and of inflammation than are the more delicate structures of the spinal cord, it follows that the symptoms of lesions of nerves are often, or for a long time, only irritative (pain, spasm), while those of lesions of the spinal cord almost immediately become paralytic (anæsthesia, paralysis).

Having examined his patient, the surgeon can easily put any case into one or other of these groups: (1) cases of obvious deformity, (2) cases without obvious deformity, (3) cases of tumour of the spine or spinal cord. He should proceed with his diagnosis as follows:

1. CASES WITH OBVIOUS DEFORMITY OF THE SPINE

i. If the natural curves of the spine are lost, and in their place there is a general convexity of the spine backwards which disappears when the child lies down, and is altered by movement, it is due to **spinal muscular debility.** In young children this is usually caused by rickets, and if the long bones are bent, with swellings over their epiphyses, and the fontanelles are found open too late, etc., it is to be diagnosed as a **rachitic spine.** It is also met with in patients convalescing from severe illness which has kept them in the horizontal position for a long time.

ii. In an adult a similar rounded curve of the cervico-dorsal region is met with as the result of **faulty attitude.** In young people the curve can be corrected; in them it may be due to defect of vision: later in life it cannot be corrected, and changes in the outline of the bones and in the joints are found; it is then known as an **occupation curve.**

iii. If such a general posterior curve of the spine is a fixed curve, unaltered by recumbency or movement, and if the movements of the spine are greatly diminished or almost nil, and the chest is also fixed, breathing being entirely diaphragmatic, and the skiagram shows synostosis of the bodies of the vertebræ and lipping of the articular processes, it is due to **spondylitis deformans.** This condition is generally attended with severe pain. It may be met with in young adults, usually as a consequence of gonorrhœa, but is more frequent in later life. It is distinguished from caries of the spine by the less abrupt character of the curve, by the absence of tenderness to vertical pressure, in many cases by the pain being worse at night, and sometimes by the patient being conscious of a grating in his spine during movement. There is often osteo-arthritis in other joints. If a similar general rounded curve of the spine in an elderly person is associated with enlargement and curving of clavicles, femora, or tibiæ, it is a part of **osteitis deformans.**

iv. If there is an abrupt curve of the spine backwards, or a projection posteriorly of one or more of the spinous processes, and the skiagram shows destruction of the cancellous bone of the front of the spine, it is a case of **Pott's disease** or **angular curvature,** or, better, **tuberculosis or caries of the spine.** When the projection is great the evidence of fall of the upper part of the spine is obvious. When the deformity is of long standing the spine above, or below, or in both situations will show a compensatory curve forwards.

In all cases of caries of the spine the surgeon should carefully examine for abscess, and for evidence of nerve lesion. The **abscess** may be found at the back, but more frequently the pus travels down along the front of the spine. When the disease is in the neck the surgeon should examine the back of the pharynx, the posterior triangle, the axilla, and the suprasternal notch. In disease of the dorsal spine each psoas muscle should be examined; if no swelling is detected, but either hip is flexed, it indicates inflammation of the muscle, and the formation of a tuberculous abscess will speedily follow. In disease lower down the abscesses are found in the sheath of the psoas or iliacus, or passing into the pelvis, and pointing at the buttock or the perineum. An abscess of any size can be seen in a good skiagram. The examination of a case of caries of the spine, in whatever stage the disease may be, is not complete unless a careful search is made for abscess connected with it.

If with this condition the lower limbs are in a condition of *spastic paralysis*, with exaggeration of knee-jerk, it indicates pressure upon the front of the spinal cord by a mass of tuberculous granulation tissue or by an abscess; but if there has been a sudden development of *flaccid paralysis* of the lower limbs it indicates the bursting of an abscess into the spinal canal. If the case is of long standing and has not altered for years, and if there is no hyperæsthesia of the spine to vertical pressure or jars, and the skiagram shows that the bodies of the vertebræ are firmly ossified together without any areas of rarefaction of bone, or abscess, the tuberculosis is *cured.* (*See also* p. 405.)

v. An abrupt break in the line of the lumbar spines with a deep sulcus over it is due to **spondylolisthesis,** i.e. a partial forward dislocation of one of the lumbar vertebræ, usually the 4th or 5th.

vi. When there is a lessening of the natural curve of the dorsal region, the dorsal spine being straight and sunk in between the scapulæ, there is rotation of the spine. If the surgeon finds that on one side (say the right) the angles of the ribs are more prominent posteriorly than on the other, and that the scapula is higher and more prominent, that the right side of the waist is hollow, and the iliac crest apparently prominent, while on the left side the hollow of the waist is obliterated or less marked, but the transverse processes of the lumbar vertebræ project backwards, there is rotation of the spine, **scoliosis,** or what is generally known as **lateral curvature.** In corroboration of this he will look for flattening of the right chest in front, and projection forwards of the left breast and of the left anterior iliac spine, and also lateral deviation of the spinous processes, to the right in the dorsal region, and to the left in the loins. The curves may be found reversed. If the surgeon relies upon the deviation of the spinous processes instead of upon the evidence of rotation he will fail to diagnose many cases, and will fail to appreciate the gravity of others. If the rotation is slight, and disappears at once on lying down, it is often called a *weak spine.* Cases in which the deformity, although it is more marked, can yet be corrected by vigorous and well-directed muscular effort and position, must be distinguished from those in which the rotation is *permanent* and associated with changes in the shape of the bones, as shown in a skiagram. When the affection comes on suddenly with great wasting of the spinal muscles, and the deformity is very pronounced, the cause is *paralytic*—poliomyelitis. The surgeon should examine the feet, knees, thighs, and hips, to detect any cause of asymmetry of the lower extremities which can cause obliquity of the pelvis and tilting of the spine. Among such causes are flat-foot, genu valgum, hip disease, congenital dislocation or ankylosis of the hip, and a badly united fracture of thigh or leg.

vii. If the spine is curved with a long sweeping bend to one side, without rotation of the vertebræ, the curve being permanent in every position, it is due to **retraction** of the opposite side of the chest, probably from *pleurisy* or *empyema.*

Grave deformity of the spine is sometimes caused by *carcinoma* of the spine (*see* p. 407).

2. CASES WITHOUT OBVIOUS DEFORMITY OF THE SPINE

i. If the surgeon finds that one part of the spine is kept rigid, that attempts to move it cause pain which the patient instinctively avoids, that vertical pressure down the spine causes pain, and that for this reason the patient avoids all vertical jars and pressure through the spine, and the skiagram shows rarefaction of the body of one or more vertebræ, he should diagnose **tuberculosis of the spine,** even before there is any angular curvature from destruction of the bodies of the vertebræ. The surgeon's attention may be first directed to the spine by the detection of a spinal abscess; or the first symptom complained of may be pain referred to the distribution of the nerves arising from the affected region of the spine, e.g. girdle pain when the lower dorsal region is the site of the disease.

ii. Where, however, the patient complains of a fixed pain in the spine, and the skin of this region is found hypersensitive to pressure, or to heat or to cold, but vertical pressure through the spine is not resented, and the spine is not rigid at the painful part, the disease is **hysteria.** Such cases are usually met with in young women, but are not limited to them; there will probably be exaggeration of the knee-jerk, and there may be a false ankle-clonus. The surgeon should endeavour to distract the patient's attention from his examination, when he will probably find that the painful part can be freely manipulated and pressed upon without causing signs of pain. In these cases, too, the hyperæsthesia is very superficial, being in the skin rather than in the subjacent bones. The patient may give a history of injury.

iii. The signs of **nerve lesion** are pain and hyperæsthesia, twitchings and paralysis, and increased deep reflexes. They are due to irritation and compression of the spinal cord, or of the nerves arising from it, and an attempt should be made to distinguish these conditions. If the patient complains of severe pain along certain nerves, and the painful region is hyperæsthetic, these symptoms may be attributed to *neuritis.* When there is considerable deformity of the spine, with spastic paralysis of the lower limbs, it is to be attributed to *compression of the cord.* When these symptoms have come on rapidly the pressure is due to an *abscess* in the spinal canal. If, however, the paralysis is limited to the muscles supplied by certain nerves issuing from the diseased part of the spine, it is to be attributed to *compression of those nerves.* If the patient suddenly becomes paralysed without any pain or hyperæsthesia, and the legs are flaccid, and there has not been any sudden increase in the deformity to explain it, the cause is either the bursting of an abscess into the spinal canal or a sudden hæmorrhage compressing the cord.

iv. When the coccyx or the joint between it and the sacrum is the supposed seat of disease, the part must be examined with some care. If the hand detects heat or swelling and tenderness over the part, and on introducing the finger into the rectum the least movement of the coccyx is found to cause acute pain, **disease of the sacro-coccygeal joint** is to be diagnosed. This will be confirmed if there is an abscess pointing either on the outer or the inner surface of the bone.

v. If, however, there is no local redness or heat or swelling, but the coccyx is the seat of severe pain and some tenderness, so that sitting, coughing and sneezing are painful, and defæcation and examination per rectum and movement of the coccyx on the sacrum are very painful, it is to be considered a case of **coccygodynia.** This affection is most common in women, and often follows an injury to the part.

vi. When in a new-born child a dimple is seen fixed to the spine and serous fluid escapes from it, it is a **myelocele.** The subjects of this deformity are usually either still-born or very quickly die.

vii. A sinus over the coccyx, unconnected with the bone or the anus, and having a very chronic history, is a **coccygeal sinus** due to imperfection in the closure of the lowest part of the spinal furrow. A dimple in the skin over the sacro-coccygeal joint is the result of a less degree of the same defect.

viii. If one or more of the vertebral spines is absent the condition is known as **spina bifida occulta.** This is most often met with in the lumbo-sacral region, and the skin of the part is generally covered with long dark hair. Perforating ulcer of the sole and other trophic changes, with or without talipes, may be present.

ix. **Carcinoma** is met with as a secondary growth in the spine, especially in connexion with mammary cancer. Where a patient who has, or has had, cancer in the breast complains of pain in one part of the spine and along the nerves passing through the intervertebral foramina, a secondary growth here is to be suspected. And if the pain persists, in spite of treatment, and the spine becomes rigid or all movement in it is very painful, and there is an extensor reflex of the great toe, this suspicion is confirmed. If in a skiagram the outline of the spine is deformed, and there is a shadow less dense than that of the spinal bodies extending into and around the spine, the diagnosis is assured. The growth of the tumour can be watched in successive skiagrams or inferred from the extension of the nerve changes and the occurrence of paralysis. If a tumour develops in the spine, or if there is deformity from falling forwards or downwards of the vertebræ above, the diagnosis becomes unmistakable. The final deformity may be great.

3. TUMOURS OF THE SPINE

Tumours of the spine are separated into the *congenital* and the *acquired.* In examining a **congenital tumour** of the spine the surgeon must first endeavour to ascertain *whether it communicates with the spinal canal and the spinal membranes.* For this purpose the following points must be observed:

i. *Position.*—A central position is characteristic of all intraspinal congenital tumours, and if a tumour is found not to occupy the median line it is very unlikely that it communicates with the spinal canal.

ii. *Condition of the spine.*—If a bony rim is seen or felt around the sessile base of the tumour, this favours its intraspinal nature; whereas if the laminæ and spines can be traced entire beneath the swelling, it is extraspinal.

iii. *Reducibility of the tumour* is a very important sign of its intraspinal origin, especially if the reduction of the tumour leads to increased tension of the fontanelle or to nervous symptoms.

iv. *Increased tension of the tumour* during crying or strong expiratory efforts is of similar import; this, however, when unaccompanied by reducibility of the tumour, may be due to proximity of the swelling to the rectum or abdominal viscera.

v. *Complications.*—Of these the most important are hydrocephalus, club-foot, paralysis of the lower extremities or of the rectum or bladder, and a thinning, or entire absence, of the skin over the tumour.

vi. The tumour should be examined with transmitted light, and if an opaque band or cords are seen in it corresponding to the spinal cord or nerves, it indicates the intraspinal nature of the tumour.

vii. The *contents of the tumour* may be examined, and if found to be cerebro-spinal fluid this will prove the swelling to be intraspinal. By these signs the first step in the diagnosis can be taken.

Extraspinal tumours must be examined to determine whether they are solid, fluid, or composite, and with what part of the spine or pelvis they are connected. In the case of tumours of the sacrum or coccyx the motions should be examined to see whether any of the contents of the tumour pass into the bowel, and if so a close relation of the tumour to the bowel may be predicated. The surgeon will, of course, examine the interior of the pelvis by means of the finger in the rectum.

i. If a congenital tumour situated over and fixed to the middle line of the spine is found to fluctuate, to become tenser when the patient cries or strains, and to be partially reducible within the spine by gentle pressure, with increase of the tension of the fontanelle, or with the production of nervous symptoms, it is a **spina bifida.** This diagnosis will be corroborated by feeling or seeing the defect in the laminæ, and by finding any of the frequent complications of this affection (hydrocephalus, talipes, or paralysis), and by an examination of the fluid in the sac. If the tumour is covered by healthy skin, is translucent throughout, and there are no nerve complications, it is a **meningocele.** If healthy skin is wanting over a part of the sac, being replaced by a thin vascular, or nævoid, membrane, or if the spinal cord or nerves can be seen crossing the sac, or if there are nerve complications, it is a **meningo-myelocele.**

ii. If a congenital tumour fixed to the spine is found to fluctuate in every part, and if its coverings are thin or translucent, but the tumour is incompressible and unaffected by the cries or straining of the patient, and unaccompanied by hydrocephalus, talipes, or paralysis, it is a **false spina bifida**, or a hernial protrusion of the spinal membrane, which has become shut off from the theca vertebralis.

iii. A small cyst over the back of the lower end of the coccyx, attached loosely to both the bone and the skin, and not communicating with the spinal canal, is a **coccygeal cyst**, arising from non-obliteration of the lowest part of the spinal furrow.

iv. If a congenital tumour growing from the sacrum or coccyx is sessile, in parts fluid, in parts solid, and therefore varying in consistence in different situations, extends into the pelvis and receives an impulse from the rectum, or communicates with that viscus and discharges into it, it is a **sacral tumour.**

v. Where a congenital tumour of this region is felt to contain firm masses of cartilage and bone, and has ill-developed or perfect fingers or toes appended to it, it is a **fœtal tumour** or **teratoma.**

vi. A congenital solid tumour of the spine with lobulated outline and of soft consistence is a **congenital lipoma.** Such a tumour may extend into the spinal canal and be very firmly fixed to the spine, and then it may be complicated with paralysis of the lower extremities.

vii. If a congenital tumour over the spine is found to be reducible by compression, and to fill out with coughing or straining, but does not fluctuate and is not translucent, it is a **nævus.** If the skin over it is nævoid or thinned, and allows the blue colour of the blood in the tumour to be seen through it, the diagnosis becomes easier.

Acquired tumours of the spine offer no special features, and are to be recognized by common characters. In this region *sebaceous cyst, lipoma, fibroma, carcinoma,* and *sarcoma* are met with, and a *bursa* may develop over the vertebra prominens, or in men lower down where the braces cause pressure, and if irritated may inflame and suppurate; it presents the signs of bursal cyst in other situations. In all these cases the surgeon must endeavour to trace the spinous processes beneath the tumour, and so convince himself of the integrity of the spinal column. Very large *abscesses* in connexion with caries of the spine may be met with in either the neck, the back, or the loins.

4. TUMOURS OF THE SPINAL CORD

Non-congenital tumours arising within the spinal canal form a group by themselves. The diagnosis rests upon the observance of the signs of progressive irritation and compression of nerve-roots and of the spinal cord itself, and the exact distribution of the nerve symptoms is the key to the localization of the tumour.

Persistent pain referred to the area of distribution of one or more nerve-roots, followed by progressive anæsthesia and paralysis, points to the presence of a tumour involving the spinal cord.

1. If the root pain is well marked and severe, and is gradually followed by spastic paralysis of the limbs below, with increased knee-jerk and extensor plantar reflex, and loss of sphincter control, the tumour is situated *outside the spinal cord.*

2. If with less pain paralysis both of motion and sensation comes on early, and quickly becomes complete, the tumour is *in the spinal cord* itself.

3. If the paralysis is of the flaccid type, with muscular wasting and electrical changes in the

paralysed muscles, it points to the tumour involving the nerves of the *cauda equina*.

To determine the exact position of a spinal-cord tumour, care must be taken to map out exactly the area in which pain is felt, and to note areas of hyperæsthesia, anæsthesia, paralysis, and muscular wasting. Localized pain and anæsthesia indicate the posterior nerve-roots involved; local paralysis, flaccid wasted muscles, and the reaction of degeneration are the effects of pressure upon anterior nerve-roots; spastic paraplegia with more or less complete anæsthesia without muscular wasting or electrical changes is the result of destructive pressure upon the cord; there is often a zone of hyperæsthesia just above the anæsthetic area. The highest nerve-root affected indicates the upper level of the tumour. The following table forms a rough guide to the levels on the trunk of sensory nerve distribution:—

Suprasternal notch = 3rd and 4th cervical.
Level of nipple = 4th dorsal.
Ensiform cartilage = 7th dorsal.
Umbilicus = 10th dorsal.
Ant. superior iliac spine = 12th dorsal.

CHAPTER XXIX

DIAGNOSIS OF DISEASES OF THE LIPS AND FACE

The surgical affections of this region are numerous they may be considered in the following order:

1. **Congenital deformities.** — **Hare-lip** is readily recognized; it may be uni- or bilateral, *simple* when it involves the soft structures only, *alveolar* when the maxilla is also cleft, and *complicated* when there is an associated cleft of the palate. Very rarely is the cleft central in position. In some cases of hare-lip the lower lip is the site of *mandibular recesses*, i.e. two short sinuses opening on either side of the central point of the lip. As rare facial deformities may be mentioned **lateral facial cleft**, i.e. a fissure extending from the lip up the side of the nose to the inner canthus, sometimes laying open the nasal duct and often associated with a coloboma of the iris; and **macrostoma**, a condition in which the mouth extends outwards as a cleft for a varying distance through the cheek.

2. **Ulcers.**—Notice particularly the age of the patient, the duration and mode of onset of the disease, the character of the ulcer—whether single or multiple, whether the edge is undermined, punched out, or thickened, whether the base is indurated, smooth, sloughy, or irregular and fungous—and the condition of the associated lymphatic glands. In some cases it is necessary to examine the discharge

for the *Spironema pallidum*, and to apply Wassermann's test to the blood.

i. If the ulcer is single, of short duration, with distinct induration of the edge and base, and the surface is abraded, ulcerated, or covered with a very thin whitish slough, and several of the glands are enlarged, firm, and freely movable under the skin, it is a **hard chancre.** The diagnosis should be established by finding the *Spironema pallidum* in the discharge. This affection is more common on the upper lip than the lower, and in women than men. A chancre of the lip is, as a rule, accompanied by swelling and eversion of the whole lip, its induration is more spongy than in genital chancre, and the enlargement of the submaxillary glands is considerable, much greater than of those of the groin. The presence of signs of secondary syphilis will confirm the diagnosis.

ii. If the ulcer commenced in early life, has been very chronic and slow in its progress, and was preceded by soft, raised, apple-jelly-like nodules, some of which are also found scattered around it, it is **lupus.** There may be other signs of tuberculosis. The lymphatic glands of the neck may be normal, and if enlarged this is not secondary to the lupus, nor is it limited to the immediately associated glands. The discharge often forms adherent crusts. (*See* p. 296.)

iii. If the ulcer originated in firm, red, angry-looking nodules, which quickly broke down into ulcers with a punched-out appearance, with sharply cut edge and sloughy base, and the lymphatic glands are not enlarged, it is a lesion of **tertiary syphilis.** A positive Wassermann reaction and other evidences of syphilis should be sought for to confirm the diagnosis. Syphilis is much more, and more rapidly, destructive than lupus.

iv. If the ulcer commenced in a small crack or wart, and the base and edge of the ulcer are thickened and firm, the former being irregular or granular in appearance, and if the associated lymphatic gland is enlarged, it is **epithelioma.** This ulcer is usually single, but it may occasionally be multiple; e.g. more than one epitheliomatous ulcer of the lip, or epitheliomata on the opposing surfaces of the two lips, may be seen. The patient is usually past middle age.

v. An ulcer occurring in a person past middle life, which slowly and steadily progresses, with a smooth base, with a very narrow line of induration around the edge, and without any enlargement of the lymphatic glands, is a **rodent ulcer.** Such an ulcer may exist for many years, and cause wide and deep destruction of tissue, and a great chasm in the face. It may heal up and then break out again. It commences in a flat papule, and is most common at the side of the nose, on or near the lower eyelid, or near the angle of the mouth.

3. **Acute inflammation and gangrene.**—There are three varieties of acute gangrene of the face that must be distinguished from one another, viz. *cancrum oris*, *anthrax*, and *carbuncle*. If in a child, during or just after an attack of one of the exanthemata, one cheek becomes acutely swollen and an ulcer is found on the mucous surface, the base of which sloughs, and the ulceration and sloughing rapidly extend, it is **cancrum oris** or **noma.** The ulcer may perforate the cheek and cause extensive destruction of soft parts and necrosis of bone. The tongue is thickly coated, the breath very foul, and the temperature and pulse-rate are both high.

A flat, slightly raised, livid lump on the face or neck, with a central black slough, surrounded by a ring of vesicles which are at first separate and quickly coalesce with the central swelling, is the "malignant pustule" of **anthrax.** The source of infection can be traced to contact with horses, furs, or hides. Constitutional disturbance follows the local lesion after an interval of a day or two; it may end in *septicæmia.* The *Bacillus anthracis* can be detected in the fluid of the vesicles.

A firm, painful, and œdematous swelling of the skin and subcutaneous tissue, in which foci of suppuration quickly appear, accompanied from the first by a rise of temperature, is a **carbuncle.** Extensive sloughing occurs, firm and tender lymphatic or venous cords are felt, the neighbouring glands are swollen and painful. Staphylococci are found in the pus. The disease runs a more rapid course and is more serious when it is situated on the face than when it occurs elsewhere.

Erysipelas of the so-called idiopathic variety, i.e. arising in the absence of a demonstrable breach in the skin, is prone to occur upon the face. The constitutional symptoms vary in different cases from only slight pyrexia to high fever and delirium. (*See* p. 28.)

4. **Sinus.**—If a sinus in the cheek discharges a thin watery fluid, which streams out during mastication, it is a **salivary fistula.** The nature of the fluid should be tested by its amylolytic action. The patient may notice a dryness of the mouth on the same side.

If the sinus is puckered in and adherent to the bone, it should be carefully explored with a probe for **necrosed bone** or a **carious tooth.** In all such cases the teeth should be carefully examined. A skiagram will be useful.

5. **Fluctuating tumours.** i. **Acute.**—If a tumour immediately follows an injury, and is attended

with bruising of the skin, it is a **hæmatoma.** These tumours sometimes give a creaking sensation to the fingers. If attended by the signs of acute inflammation, the swelling is an **abscess.**

ii. **Chronic.**—If painless, globular in outline, adherent to the skin, and freely movable over the deeper structures, the tumour is a **sebaceous cyst.** These cysts are most common in the region of the whiskers. A cyst with these characters, except that it is not adherent to the skin, especially if it occurs in a young person, is a **dermoid cyst.** Such a cyst is commonly situated at the outer or inner angle of the orbit or at the side of the nose. A cyst in the cheek, which becomes more tense during mastication, is a **salivary or parotid cyst.** If the cyst is deep beneath the parotid gland it may be difficult or impossible to detect fluctuation in it, and it is then liable to be mistaken for a solid tumour; but the smooth rounded outline and elastic consistence are unlike solid growths, and if any variation in size with mastication is observed it makes the diagnosis certain. A cyst under the mucous membrane of the lip,. with a bluish colour, is a **mucous labial cyst.**

6. **Swellings in the parotid region.**—This region is bounded above by the zygomatic arch, below by the angle of the jaw, and behind by the edge of the sterno-mastoid muscle, while in front it reaches forwards over the masseter muscle.

i. A swelling, quite superficial, freely movable over the deeper parts, and ovoid in shape, is an **enlarged lymphatic gland.** The gland may be enlarged by simple inflammation, by tuberculous disease, or by secondary malignant disease. A tuberculous gland may be solid or softened down into a fluctuating swelling. A cancerous gland rapidly becomes fixed to the parotid gland and to the skin.

ii. A general acute swelling of this region, with tenderness and pain increased by mastication, and attended with fever, is **acute parotitis.** If occurring primarily, affecting both glands, and accompanied by a mild febrile course, it is **mumps.** This generally occurs in children or young persons, and may attack several members of a family. The submaxillary and sublingual glands, as well as the testicle, ovary, or mamma, may also be affected. Parotitis is met with, too, as a sequela of acute specific fevers, or in septicæmia and pyæmia, and is still very occasionally encountered after abdominal operations. If the surface becomes œdematous, and the pain and tension increase, and especially if rigors occur or fluctuation can be detected, there is a **parotid abscess.**

iii. A slowly growing tumour situated below and in front of (sometimes behind) the lobule of the ear, movable under the skin and in the parotid gland, is a **parotid tumour.** Its mobility in the parotid gland varies with the position and depth of the tumour; if part of the tumour lies deep in the gland between the ramus of the jaw and the skull, its range of movement is limited by the bones. These tumours differ in shape, but are usually coarsely lobulated. They may be moderately soft, or firm, or very firm, and they may vary in consistence in different parts. These differences are associated with varieties of structure, myxomatous tissue being soft, fibrous and sarcomatous tissue being firm, and cartilage being very firm or hard. All these structures, and sometimes also adenoid tissue, are found in varying proportions in these tumours.

iv. A chronic but steadily increasing swelling immovably fixed to the gland and firm in consistence is a **malignant tumour of the parotid,** usually a carcinoma. Later on it becomes fixed to the bones and the skin, it may ulcerate and fungate on the face, and be attended by secondary enlargement of the cervical glands. Severe pain in the ear and up along the side of the head, inability to open the mouth, facial palsy, and deafness are characteristic effects.

7. **Other affections of the lips.**—A congenital thickening of one lip, due as a rule to the presence within it of dilated lymph-spaces, is known as **macrocheilia.** A chronic thickening of the lip, leading to eversion of its red border, and associated with slow superficial ulceration of its mucous surface, may be a part of the so-called strumous diathesis—**strumous hypertrophy**—or may be due to **syphilis**; the history of the case, the characters of associated lesions, and the Wassermann reaction enable the distinction to be made between these two causes. Small, firm, shot-like nodules felt under the mucous membrane of the lip are **adenomata** of the mucous glands of the lip. Larger tumours in this situation, if fluid, are **mucous cysts,** and if solid are **labial tumours,** often containing myxomatous tissue and cartilage as well as glandular tissue and small cysts. Groups of small clear vesicles on a bright-red base, drying up into a thin yellow or brown scab, and attended with itching and smarting, are **herpes.**

Chronic fissures at the angle of the mouth, with a watery discharge, are **syphilitic rhagades**; they are often seen in children the subjects of inherited syphilis, and they leave behind puckered scars. Flat, slightly raised patches of mucous membrane of a pale bluish-white colour are **mucous patches.** Irregular fissure-like ulcerations of the mucous surface, chronic in character, and painful, are **syphilitic ulcers.** Corroboration of the diagnosis in these last three cases should, of course, be sought in other syphilitic manifestations, in the detection of the *Spironema pallidum*, or in Wassermann's reaction.

Small whitish spots on the mucous surface, which terminate in very superficial circular abrasions or ulcers, are **aphthæ**; adjacent ulcers may coalesce. Aphthæ are attended with pain, soreness, and increased flow of saliva. **Thrush** may be found on the lip, in the form of opaque white streaks and patches, painless and not causing ulceration. If the white material is removed, and examined microscopically, it is found to contain the fibres and spores of a fungus, *Oïdium albicans*.

8. If a patient has an acute, painful and very tender œdematous swelling over either jaw, it is probably an **alveolar abscess** (*See* p. 384.)

CHAPTER XXX

DIAGNOSIS OF DISEASES OF THE NOSE

The four chief signs of disease of the nose are (1) epistaxis, (2) discharge, (3) obstruction, and (4) deformity; and it will be well to consider these individually before proceeding to the diagnosis of separate diseases.

1. **Epistaxis,** or bleeding from the nose, may be *traumatic,* and occasioned by direct injury of the nose itself, or by fracture of the base of the skull (*see* p. 83), or *idiopathic.* When idiopathic it may result from local congestion, from disease of the vessels, from altered blood states, from ulceration of the mucous membrane, or from rupture of vessels in very vascular growths in the nose. Idiopathic epistaxis occurring in young persons otherwise in good health, and especially when preceded by flushing of the face, noises in the ears, giddiness, and headache, is to be attributed to *congestion;* when occurring in the course of fevers or in patients with disease of the liver, it is due to *alteration in the blood* as well as to congestion. A common cause of repeated bleeding from congestion caused by blowing the nose, etc., is a patch of varicose veins situated on one or both sides of the antero-inferior part of the septum, and readily recognized on examination with a speculum. Profuse hæmorrhage in healthy adults may sometimes be due to a small *ulcer* on the septum which has perforated an artery. In elderly patients,

when preceded by signs of cerebral congestion, and the blood is dark and venous in character, it is due to *congestion;* but when the blood, bright red in colour, flows out very fast, and especially if the superficial arteries are tortuous and rigid, it may be attributed to *rupture of an atheromatous artery.* Epistaxis also occurs in *hæmophilia.*

2. **Discharge from the nose** varies much in its characters; it may be very thin and watery, mucous, muco-purulent, purulent, sanious, mixed with foul-smelling crusts, odourless, or horribly offensive. Mucous and muco-purulent discharge is caused by acute and chronic catarrh. Purulent discharge may be due to empyema of the antrum, to ulceration of the mucous membrane of the nose, especially after impaction of a foreign body, or to suppuration in the frontal, ethmoidal, or sphenoidal sinuses. Sanious pus indicates ulceration, or in acute cases intense congestion. Great fetor of discharge indicates retention of the matter in the nose and its decomposition, and is usually associated with syphilitic ulceration of the mucous membrane or atrophic rhinitis.

Something may be learnt from the mode of escape of the discharge. Where this is constant it is probably secreted by the nasal cavity itself; where more or less intermittent it points to the fluid accumulating in some neighbouring cavity, and from time to time escaping into the nose; if the flow of fluid is greatest when the head is resting on the opposite side, this strongly indicates that it is secreted in the antrum; when position has no influence upon the flow it may come from the frontal or other sinuses, and inquiry should be made for local pain. Pain in the region of the eyebrow, the cheek, and more rarely in the upper teeth suggests disease in the antrum; if above the eyebrow, between it and the hair-line, in the frontal sinus; if behind the eyes and in the occipital region, in the sphenoidal sinus; and if over the bridge of the nose, in the ethmoid sinus. In any of these the pain usually comes on in the morning and is relieved towards the evening.

3. **Obstruction of the nose** is indicated by a "nasal" tone of voice, by the patient's inability to blow down or to sniff up through the affected nostril, and rarely also by epiphora. It may be due to displacement of the walls of the nose from fractures and other injuries, to deflection of the septum, to outgrowths from the walls or neighbouring cavities into the nasal fossæ (swelling of mucous membrane, spurs, polypi, hæmatoma, abscess, and sarcoma or carcinoma of upper jaw or sinuses, etc.), or, in children especially, and when unilateral, to foreign bodies blocking up the passage. Similar obstruction to respiration may be due to adenoid vegetations and tumours in the naso-pharynx and to adhesion of the soft palate to the back of the pharynx. With mucous polypi the obstruction is greater in damp than in dry weather.

4. **Deformity of the nose** may be **congenital** or **acquired**; when the latter it is either *traumatic*, the direct result of the violence, or *idiopathic*, occasioned either by imperfect development of the nose, deviation of the septum, by destruction of more or less of the bony framework of the nose and collapse of that feature, or by distension of its cavity by the progressive growth of a tumour within it. The distinction between these forms is therefore quite obvious. When the nose is greatly widened transversely, and the eyes pushed outwards and separated from each other, as occurs in chondroma or chondro-

sarcoma, the deformity, which may reach a hideous degree, is known as "frog-face."

Examination of the nose.—The nose should first of all be examined externally to detect any alteration in its contour. Compressing one nostril with his finger, the surgeon should request the patient to breathe deeply through the other, when the fact of obstruction will be at once apparent; the other nasal fossa must be similarly investigated. Then, placing the patient facing a good light, he should gently press up the tip of the nose, when he will be able to see the anterior nares and the septum, and detect deviation of the septum, ulceration of the anterior nares, or a presenting polypus. To examine the cavity of the nose a speculum should be introduced, and a strong light thrown in by means of a mirror. The condition of the inner and outer walls, the size of the space between, and the nature of any discharge must be noted. If a spur, growth, or obstruction is seen, a probe should be passed up to ascertain its consistence, and an attempt made to move it. In cases of purulent discharge, pains must be taken to determine whether the pus escapes into the nose from beneath the middle and over the inferior turbinate bone—in which case it is coming either from the antrum, the frontal sinus, or the anterior ethmoidal cells—or flows over the middle turbinate bone from higher up, that is, from the posterior ethmoidal cells, or the sphenoidal sinus. The posterior nares may be examined with the finger passed up behind the soft palate, or by "posterior rhinoscopy," a small mirror being introduced into the pharynx behind the velum, and illuminated by light reflected from a head mirror through the mouth; if the patient is under the influence of an anæsthetic the surgeon can more satisfactorily examine the posterior nares with the finger passed behind the soft palate.

Nasal symptoms are often due to disease of the frontal or ethmoidal sinuses or of the antrum of Highmore. The condition of these cavities can be investigated by "transillumination." In a darkened room, a small electric lamp is placed in the patient's mouth with the lips closed. The areas of light and shade on the two sides of the face and forehead are compared.

The diseases of the nose will, by means of this examination, readily be divided into those in which there is obvious obstruction to respiration, and those in which there is discharge only, the nasal fossæ being free. The cases in which the discharge has a very offensive penetrating odour are known as cases of ozæna.

1. **Inodorous discharge without obstruction.**—If the discharge is mucous or muco-purulent it is known as **chronic coryza.** Where this occurs in infants, and leads to difficulty in sucking, and snuffling respiration ("the snuffles"), it is a characteristic feature of **inherited syphilis.** When with this discharge the mucous membrane over the turbinate bones is found thickened and uneven there is chronic **hypertrophic rhinitis.** The thickened mucous membrane may look like a polypus, but it is found not to move over the bone when pressed by a probe, and contracts readily under cocaine and adrenalin. Fissures and small ulcers in the mucous membrane are probably **syphilitic,** and the patient should be carefully examined for other evidences of secondary syphilis. In middle-aged and elderly persons the lining of the nostril may be found red and irritable, with dry adherent scabs, or thin watery discharge—**eczema**; such patients are often gouty.

If the discharge of pus is more abundant, and occurs periodically, especially when the patient lies down on the opposite side, or blows his nose violently, it is probably an **empyema of the maxillary antrum (sinus).** If any of the upper teeth are carious, this will support the diagnosis. In these cases there is no distension of the antrum; the patient may be conscious of an unpleasant smell, and of a nauseous taste in the morning from the pus trickling into his pharynx. The pus may be seen flowing into the nose, over the inferior turbinate bone (concha), and the antrum may be found to be opaque to transmitted light. Suppuration in the antrum is often attended with pain around the orbit, in the cheek, or in the upper teeth. The diagnosis can only be finally established by puncture of the antrum. If there is a continuous discharge of pus from under the middle turbinate bone, associated with headache and sleeplessness, and unaffected by position, it is probably due to **suppuration in the frontal sinus**; tenderness over the sinus with frontal pain will strengthen this supposition. Confirmation may be afforded by a skiagram. Pain over the bridge of the nose, and between the eyes, with a similar discharge of pus into the middle meatus, is characteristic of disease of the **anterior ethmoidal cells.** If the pus is seen to flow down over the middle turbinate bone or into the naso-pharynx it probably comes from the **ethmoidal sinuses** or **posterior ethmoidal cells**; a probe may occasionally detect necrosed ethmoid bone.

A free discharge at times of clear watery fluid, frequently preceded or accompanied by a paroxysm of sneezing, indicates a **vaso-motor rhinitis.** This condition may be a symptom of mild sinus infection. In all cases it indicates irritation of the nasal mucosa. Hay-fever is a form of this condition.

If, following an injury to the head, there is a constant or intermittent trickling of thin watery fluid from one nostril, and the nasal cavity is quite free, the fluid may be cerebro-spinal, escaping from the subarachnoid space. (*See* p. 82.)

2. **Ozæna.**—The immediate cause of this condition is the decomposition of retained and dried secretion due to the loss of the cilia on the surface of the mucosa, with consequent stagnation. It occurs as a manifestation of late syphilis, and as a non-syphilitic "atrophic rhinitis." In the former there may be a clear history of syphilis, the Wassermann reaction is positive, and in addition to the crusted and atrophic state of the mucosa with atrophy of the turbinate bones and roominess of the nasal fossæ, a probe may detect bare, necrosed bone.

Atrophic rhinitis occurs in young women of the poorer classes, and is never accompanied by necrosis of bone. It must not be forgotten that the impaction of foreign bodies may lead to a fetid discharge.

3 **Obstruction in the nasal fossa.**—i. If the cavity is seen to be filled up with a yellowish or bluish and semi-transparent soft body which yields and moves before a probe, or moves with strong respiration, it is a **mucous polypus.** These polypi are often multiple; they grow slowly, and never cause frequent and profuse hæmorrhages; they may cause epiphora and loss of smell, and in long-standing cases a marked widening of, and slight chronic œdema over, the bridge of the nose; they occasion more distress in wet weather than in dry.

ii. If on examining the cavity a soft mucous surface, red or dark purple in colour, is seen projecting from the outer wall of the nose, which is not moved by the probe or by respiration, it is to be distinguished as **hypertrophy** of the mucous covering of the inferior turbinated bone (concha); it is frequently seen in chronic coryza, and may be mistaken for a polypus.

iii. If the nose is found to be obstructed by a deep-red or livid mass, firm to the touch, and there has been frequent severe epistaxis, the surgeon may diagnose **fibrous polypus**, which should rather be spoken of as a **sarcoma.** This disease is most often seen in young subjects; the tumour grows steadily, and causes great distension of the nasal fossæ, spreading through the septum, widely separating the eyes, filling the antrum, and projecting into the pharynx and mouth. It does not give rise to metastases, and after puberty undergoes spontaneous retrogression. The surgeon should endeavour with probe or finger to find the point of attachment of the polyp; it may spring from the base of the skull and grow through into that cavity, causing coma and death.

iv. If on looking into the mouth in a case of nasal obstruction, a rounded bluish or semi-transparent tumour is seen behind the soft palate round which the finger can be passed freely, it is an **antro-choanal polyp**, projecting backwards from the region of the ostium of the antrum on one side. Although simple in nature, it may recur after removal with a snare or forceps.

v. **Deviation of the septum** to one side or a **spur** on the septum may cause unilateral obstruction; these conditions are easily recognized by inspection.

vi. When the septum is found projecting into both fossæ, or possibly one only, without a corresponding depression on the other side, there is a tumour of the septum. Examine whether it is solid or fluid. If fluid and quickly formed, and attended with much pain and redness, it is an **acute abscess.**

and probably a suppurating hæmatoma. If fluid, chronic, comparatively painless, and not attended with œdema, it is a **chronic abscess.** If the swelling is firm and solid, but slightly yielding, it is probably an **enchondroma,** while if of stony, unyielding hardness it is an **osteoma.** (For *hæmatoma of the septum,* see p. 114.)

vii. If a firm rounded substance is found in one or other nasal fossa, not attached to either wall, it is a **foreign body.** There may be a history of its introduction, or its examination after removal may show it to be a pea, a small marble, a wad or paper, or some similar substance. Such foreign bodies may remain in the nose for many years. If, however, it is calcareous in nature, it is a **nasal calculus**; these calculi usually develop around foreign bodies.

viii. **Warts** are sometimes seen growing from the mucous membrane; their fine-branching surface at once distinguishes them from other tumours. They may bleed readily when touched with a probe.

ix. When the tone of voice indicates nasal obstruction, which is found not to be complete, and the nasal fossæ are free, a careful examination of the posterior nares and naso-pharynx should be made, by means of a postnasal mirror or, failing this, with the finger, and if a soft mass showing deep vertical fissures is found there it will be recognized as **adenoid vegetations,** or hypertrophy of the normal lymphoid tissue of the part. This is usually met with in delicate children, often in conjunction with hypertrophy of the tonsils; as secondary effects may be mentioned a characteristic lateral flattening of the nostrils, with breathing through the open mouth and raising of the upper lip, deafness, noises in the ears, slight discharge of blood into the pharynx in the morning, excess of mucus in the pharynx, and sometimes chronic coryza with or without involvement of the sinuses.

x. Gradually increasing obstruction of one nasal fossa, especially if preceded or associated with repeated small hæmorrhages and an aching pain in the part, is characteristic of a **malignant tumour** encroaching upon the nose. Examine carefully for evidence of swelling, for displacement of bone and the protrusion of growth into the nasal fossa, and for the enlargement of glands. The growth is frequently sloughing on the surface, and bleeds readily when examined with a probe.

CHAPTER XXXI

DIAGNOSIS OF DISEASES OF THE MOUTH, TONSILS, FAUCES, AND ŒSOPHAGUS

The mouth.—The *inside of the cheek* may be the seat of mucous patches, of white patches of thickened epithelium (leucoplakia), exactly like and generally accompanying the same affection of the tongue, of syphilitic or peptic ulceration, of papilloma, submucous fibroma, and of epithelioma.

An acute superficial and very painful ulcer of the mucous membrane of the mouth, with a bright-red edge and a grey base, is a **peptic ulcer.** These ulcers are often multiple and recurrent, and are found in the subjects of chronic indigestion.

Mucous patches are recognized by their being slightly raised, and whitish in colour, and by finding the *Spironema pallidum* in the discharge on the surface, or in the fluid obtained by lightly scratching the surface. There are usually other evidences of secondary syphilis, and the Wassermann reaction is positive.

Syphilitic ulcers are irregular, sinuous, often serpiginous, with raised, sharply cut edges, and leave firm, depressed cicatrices.

Papilloma occurs as either a sessile or pedunculated outgrowth of the mucous membrane, distinguished from epithelioma by the absence of any infiltration of the submucous tissues. Ulceration may result from injury to the tumour during mastication.

Submucous fibroma occurs as a firm nodule, covered by healthy mucous membrane, which grows slowly and tends to become pedunculated.

Epithelioma here as elsewhere is known by the infiltration of the mucous and submucous tissues, the warty, ulcerated surface, and the early infection of the lymphatic glands.

A **foreign body** or a **salivary calculus** may be seen or felt in the orifice of Stenson's duct (ductus paroticus), or pus may be seen flowing from it.

Epithelioma is often met with in the *floor of the mouth*, usually starting close to the frænum linguæ. It is recognized by the signs enumerated in connexion with epithelioma inside the cheek; there is also gradual fixation of the tongue, and the diseased surface becomes fixed to or spreads over the jaw. Salivation, pain, and foul discharge are late accompaniments.

On passing the finger along the groove between the tongue and the jaw a hard, slightly tender swelling may be found; this is a **salivary calculus.** The patient will usually complain of pain and stiffness about the part, and the submaxillary gland may be found enlarged, and may be noticed to swell with each meal and to subside in the intervals.

A more or less globular, smooth, fluctuating swelling in the floor of the mouth, displacing the tongue and interfering with its movements, will be recognized as a **sublingual cyst**; three varieties can be distinguished:

1. If the cyst appears in the mouth only, is covered with thin healthy mucous membrane, and has a transparent bluish appearance, it is a *mucous cyst*, or *ranula*.

2. If the cyst is in the middle line, bulges below

the symphysis of the jaw as well as in the mouth, and has a dull white or yellow colour when seen through the mucous membrane, it is a *dermoid cyst of the thyro-glossal duct.*

3. If the cyst has these same general characters, but is under the side of the tongue and projects in the neck under one half of the jaw only, it is a *branchial dermoid cyst.*

A soft, lobulated, movable tumour in this situation is a **lipoma.**

The palate.—In examining the palate, notice first its *general form* and *integrity.* A narrow, highly arched palate is the result of imperfect development, often associated with adenoids, sometimes due to congenital syphilis. **Congenital clefts** are recognized by their median position; they may involve the uvula only, or uvula, soft palate, and just the posterior margin of hard palate, or may extend forwards to the alveolar process. Clefts in the alveolar process are not median, but on one or both sides of the intermaxillary bone. There may be a cleft of the alveolar process only, not involving the palate proper.

An **acquired perforation** of the palate is almost invariably the result of syphilitic ulceration and necrosis; in a very few cases it is the result of injury or operation. Its position, its shape, and the presence of scar tissue distinguish such a perforation from a congenital cleft.

If the soft palate is of a bright-red colour and the patient has little or no pain in it, examine carefully for other signs of **secondary syphilis**; *papules* or slightly raised flat bluish *mucous patches* are often seen in this stage of the disease.

Ulcers of the palate.—If the ulcer is superficial, covered with pale granulations, and painful, it is probably *tuberculous,* and if the patient has tuberculous disease of the tongue, larynx, or lungs, or if the tubercle bacillus is found in the secretion of the ulcer, the diagnosis is certain. A chronic ulcer starting behind the molar teeth, creeping over the palate, healing at one edge and spreading at the other, is a tertiary *syphilitic* ulcer. If an ulcer in the palate is deep, with sloughy edges and base, or with necrosis of the bone, it is a *gummatous* syphilitic ulcer. These ulcers are often very extensive, and involve the pharynx as well as the palate, and when they heal they leave perforation of the palate and cicatricial deformity. A positive Wassermann reaction will support the diagnosis. If an ulcer in the palate has a firm infiltrated edge and base, and the surface is uneven, or raised and warty, discharging a foul sero-purulent fluid, it is an *epithelioma.* Infiltration of the lymph-glands at the angle of the mandible and beneath the upper part of the sterno-mastoid muscle, the insidious origin and steady extension of the disease, and the age of the patient are important aids to diagnosis. A single ulcer in the palate, raised above the general surface, with a firm base and smooth surface, is most probably a *hard chancre ;* the diagnosis will be rendered certain by the discovery of several firm, movable glands in the neck, by the detection of the spironema in the discharge from the chancre, and by the subsequent outbreak of secondary syphilis.

Swellings of the palate.—A fluctuating swelling close to the alveolar process is most probably an *alveolar abscess ;* such an abscess may be acute, subacute, or recurrent. It may have burst into the mouth and be represented by a sinus discharging a little pus and leading down to a carious fang. Such a swelling may be a very soft *sarcoma ;* this is shown by puncture of the swelling yielding blood and not pus.

A solid tumour of the palate may be a gumma, an adenoma, or a malignant tumour. If it is softening in the centre, or ulcerating and sloughing, and the Wassermann reaction is positive, it is a *gumma*. If the tumour is well defined, covered with healthy mucous membrane, has grown slowly, or has been stationary for a time, and if it evinces no tendency to soften or to ulcerate, and is limited to the oral surface of the palate, it is an *adenoma*. If the tumour has grown rapidly, infiltrates the mucous membrane, or fungates through it, and extends into the alveolar process, nose, or antrum (maxillary sinus), it is a *malignant tumour*. The hard palate is often depressed by tumours growing in the antrum (*see* p. 387).

If a patient is taken acutely ill with dysphagia and dyspnœa, and the throat shows some swelling from the outside, while the soft palate is greatly swollen and œdematous, so as to conceal the back of the pharynx, the condition is *acute œdematous pharyngitis*.

The tonsils. 1. **Enlargements.** — If the swelling is *acute* the surgeon must inquire whether it is increasing or diminishing, and he should notice the colour of the mucous membrane, the presence of false membrane, ulcers, or sloughs, also whether any part of it is "pointing," soft to the touch, or even fluctuating, and whether there is surrounding œdema. The temperature and general condition of the patient must be carefully observed. When the swelling is *chronic*, its duration, its mode and rate of growth, its consistence, the limitation of the enlargement to the tonsil or its extension to the palate and pharynx, the condition of the mucous membrane, and the state of the cervical lymphatic glands, are the points to be observed.

i. When the tonsil is acutely swollen, deep red in colour, with œdema of the anterior pillar of the fauces, and the patient is febrile, with great pain in swallowing and discomfort from sticky mucus about the fauces, it is *acute parenchymatous tonsillitis*. If the swelling is increasing, with severe throbbing pain, and part of the tonsil is found soft, pointing or fluctuating, there is an *abscess of the tonsil*, commonly known as *quinsy*. Where small yellowish-white pea-like swellings, or ulcers formed by the bursting of small abscesses, are found on the surface, it is *follicular tonsillitis*. Follicular ulcers may coalesce into larger ulcers with undermined and swollen edges. When there is any appearance of false membrane or of acute ulceration of the surface, a "swab" should be taken and submitted to careful bacteriological examination, particularly to determine the presence of the Klebs-Löffler bacillus of diphtheria, or the fusiform bacillus of Vincent and the *Spironema dentium*, the two organisms associated in Vincent's angina. In diphtheria the membrane spreads rapidly from the tonsil on to the palate; in Vincent's angina it remains confined to the tonsil. In both there is moderate fever and enlargement of the cervical lymph-glands.

ii. When the tonsil is chronically enlarged the surgeon has to distinguish between hypertrophy and malignant tumour. If the enlargement affects both tonsils, or, affecting only one, is limited to the tonsil, which is of a healthy pink colour, often much pitted on the surface, enlarging slowly, or quite stationary, and not causing pain unless it becomes acutely inflamed, it is *hypertrophy*.

iii. When one tonsil is enlarged, the swelling being steadily progressive, and attaining a large size, involving the pillars of the fauces as well as the tonsil, and covered with livid or very thin mucous membrane which may be ulcerated, and there is enlargement of the lymphatic glands behind the angle of the jaw, the disease is *malignant tumour.* These growths are usually softer than hypertrophy. Both sarcoma and carcinoma affect the lymphatic glands, and to distinguish between them may be impossible. In young persons the disease will be *lympho-sarcoma*, but in persons past middle life it may be *carcinoma;* this is the rarer of the two diseases. The tumours when large ulcerate, and may fungate, and bleed freely.

2. **Ulcers.**—i. Small circular yellowish-grey ulcers formed by the bursting of tiny abscesses are *follicular ulcers.*

ii. A superficial ulcer, attended with slight redness of the fauces and no induration, is probably a *secondary syphilitic ulcer*, and the *Spironema pallidum* should be searched for. The tonsil is a frequent seat of *mucous patches.*

iii. If the ulcer is deep, with abrupt, sharply-cut edges and a dirty-grey base, and without well-marked surrounding induration or glandular enlargement, it is a *gummatous ulcer.*

iv. If the ulcer is single, indolent, with well-marked induration around it, and several glands under the jaw and down the neck are enlarged, hard, but quite movable, it may be a *hard chancre.* The occurrence of secondary manifestations will, of course, corroborate the diagnosis. The *Spironema pallidum* should be sought for, to make an early diagnosis certain.

v. If the ulcer is single, has a firm, uneven or warty base and thick everted edge, and spreads from the tonsil to the tongue or palate, and the glands at the angle of the jaw and under the upper part of the sterno-mastoid muscle are enlarged, it is *epithelioma.*

The **naso-pharynx** is examined by noting the freedom or otherwise of nasal respiration, the presence of discharge running down the pharynx from behind the soft palate, or the bulging of a tumour in that situation, by looking at the part as reflected in a mirror passed behind the palate, and—best of all—by feeling with the finger. In children obstruction to nasal respiration interferes with the development of the nose and face. In all patients growths in the naso-pharynx quickly cause deafness, and malignant growths in this situation, by extending into the cavity of the skull, may cause the symptoms of a cerebral tumour.

1. Where a child has a "nasal" voice, a narrow nose, keeps the mouth open with the upper lip drawn up over the incisor teeth, breathes heavily, and snores at night, the presence of **adenoids** is to be feared. If with a mirror soft lobulated masses are seen sprouting from the back of the pharynx, or if they are felt with the finger, the diagnosis is assured. These patients often suffer from epistaxis and deafness, and sometimes from morning sickness caused by the swallowing of pharyngeal mucus in the night.

2. Adults with a "nasal" voice, oral breathing, a very narrow nose, and narrow high-arched palate, with the teeth crowded in the ill-developed maxilla, are suffering from the *ill effects of adenoids* in early life, even though none may be seen or felt in the naso-pharynx.

3. A smooth, pale-blue or yellow, rounded, very soft swelling seen or felt hanging down behind the soft palate is an antro-choanal polyp (*see* p. 428).

4. A growth in the naso-pharynx which is firmer than adenoids, or ulcerated, and is attended with

deafness in one ear, fixation of the soft palate on the same side, inability to open the mouth widely, and trigeminal neuralgia, is an **endothelioma**. There is usually nasal obstruction on one side at least, and occasional hæmorrhage. The glands beneath the upper part of the sterno-mastoid muscle very soon become enlarged and fixed, and lose all definite outline. The patient is almost always a male, and very often a youth.

The pharynx.—The mucous membrane may be acutely inflamed as an extension of an acute inflammatory condition of the nose, mouth or fauces. Chronic inflammation is not uncommon in heavy smokers and public speakers, the mucosa being congested and streaked with tenacious mucus, or pale and dotted with enlarged follicles. Syphilitic ulcers occur in the pharynx. Fibroma, adenoma and myoma are very rare, but may occur as either sessile or pedunculated growths.

An acute swelling bulging forward the posterior pharyngeal wall, and producing difficulty in breathing and swallowing, is an **acute retropharyngeal abscess.** In a child this results from an acute inflammation of the retropharyngeal lymphatic glands secondary to some focus of infection in nose or face. In an adult, these glands have disappeared, and the abscess is most probably the direct result of an infected wound of the pharyngeal wall. A chronic soft, rounded, bulging forwards of the posterior wall of the pharynx is a **chronic retropharyngeal abscess** or an **aneurysm.** Feel it carefully for pulsation, which would distinguish between these two conditions. (*See* p. 102.)

Pharyngeal epithelioma.—There are important differences in this disease as it arises above the opening of the larynx, in the sinus pyriformis, or below the opening of the larynx. *Epilaryngeal epithelioma* starts in the epiglottis or in the aryteno-epiglottic fold, and spreads circularly around the pharynx. It gives rise to hoarseness, dyspnœa, and dysphagia quite early in the course of the case. *Epithelioma of the sinus pyriformis* is for a long time concealed within this deep cavity and is very liable to be overlooked. Its signs at this stage are slight hoarseness, œdematous swelling of one aryteno-epiglottic fold, the discharge of muco-pus from between this swelling and the side of the pharynx, a firm swelling of the thyroid cartilage on the same side, as felt from the neck, and, very early, enlargement of glands along the carotid sheath. *Hypolaryngeal epithelioma* is attended with early and marked dysphagia. It occurs in middle-aged women, while the other two forms are met with almost exclusively in men. In all forms the lymphatic glands are infected early, and their enlargement may be the first thing that attracts the patient's attention.

The œsophagus (gula).—The most constant symptom of diseases of the œsophagus is **dysphagia,** and it will be convenient, therefore, to deal with the diagnosis of affections of the gullet in the form of a discussion of the investigation of a case of dysphagia.

Dysphagia may be caused (1) by spasm or paralysis of the muscles of the tongue, palate, pharynx, or gullet; (2) by obstruction to the lumen of the pharynx or gullet, whether due to (*a*) swelling of its walls, (*b*) narrowing of its lumen, (*c*) pressure upon it from without, or (*d*) extension into it of growths; (3) by pain in the act of swallowing, due to either (*a*) pain in the muscles involved, (*b*) sensitiveness of the surface over which the bolus passes, or (*c*) sensitiveness in the parts which move in swallowing.

In investigating a case of dysphagia the surgeon should first notice the age and sex of the patient, the mode of onset, whether gradual or abrupt, the duration of the difficulty, and the amount of accompanying wasting. He should himself see the patient swallow, and examine any regurgitated food and fluid, noticing its amount, reaction, and odour. The mouth, the neck, and the chest should be carefully examined to detect any swelling, enlargement of glands, displacement of parts, and, especially, evidence of aortic aneurysm. The history of the patient should always be inquired into, particularly as to the swallowing of hot or caustic fluids, the impaction of bones, false teeth, or other foreign bodies, and the existence of nervous phenomena—functional or organic.

Whenever possible, an examination with *X-rays* and bismuth porridge should be made. The dark shadow of the bismuth can be traced as it is swallowed, the seat and degree of obstruction noticed, and the presence of a pouch determined. In case of doubt a skiagram should be taken. It will show a mediastinal tumour, and particularly an aortic aneurysm, if either is present. The careful passage of an *œsophagoscope* may enable the surgeon to see a foreign body in or transfixing the gullet, or ulceration, stenosis, growth, or compression of the tube by something outside it. The pulsation of an aneurysm may be seen. An œsophageal sound or bougie should only be used for diagnosis when neither X-rays nor œsophagoscope is available, as its passage is not unattended with danger. In an adult the distance from the upper incisor teeth to the stomach is 16 inches.

Dysphagia in the young is often due to congenital malformation; in those past middle life it is usually the result of malignant disease. Hysterical dysphagia is more common in women than in men, but is not limited to the female sex; malignant stricture is more common in men than in women. A sudden onset of dysphagia indicates either the impaction of a foreign body, a painful laceration, cauterization, or ulceration of the tube, the pressure of an inflammatory swelling, or muscular spasm. Occasionally the existence of a malignant stricture is first noticed through the impaction of a carelessly masticated bolus in the slightly narrowed part of the gullet. A gradual onset of dysphagia may be caused by slow changes in the wall of the tube—stricture—or by slowly increasing pressure from without from a chronic abscess, aneurysm, or other tumour. Intermittent dysphagia may be caused by hysterical spasm, or by the pressure of an intermittently forming swelling like a pharyngeal pouch. The amount of matter regurgitated at one time is an index of the existence and size of a pouch or dilatation of the tube. Patients are sometimes able to indicate accurately the level of the obstruction.

1. If a new-born infant is found to suck well but to be unable to swallow, the milk flowing out of his mouth, and if at the same time he rapidly emaciates, there is a *congenital stricture of the pharynx* at its junction with the œsophagus. By passing a small flexible metal probe the seat of the stricture can be ascertained.

2. If in a young person there is difficulty of swallowing which comes on and increases in the course of a meal, and is associated with the gradual formation of an ill-defined swelling deep in the neck, it is due to a *pharyngeal pouch*. Pressure upon this swelling may cause regurgitation of food, and as it is thus emptied, or empties spontaneously, the

dysphagia passes off. In rare cases the swelling contains only air, and is tympanitic on percussion. If the patient eats some bismuth porridge until the pouch fills out, and is then examined with X-rays and a screen, the pouch is readily seen. There may be some narrowing of the tube opposite the mouth of the pouch. Although this is a congenital condition, the patient may not complain until he has reached middle life.

3. Where dysphagia has developed rapidly, the pressure of an *abscess* should always be suspected. If a soft or fluctuating swelling can be seen or felt behind the pharynx or deep in the neck, bulging beneath the sterno-mastoid muscle, the diagnosis is clear. These abscesses may be acute, from infection, accompanied by fever and severe illness, or chronic, associated with tuberculous disease of the spine; the presence of rigidity of the cervical spine or of angular curvature of the upper dorsal spine therefore helps the diagnosis.

4. If the dysphagia came on suddenly, and at once became complete, or is complete for certain articles only, and it is found that the œsophagoscope tube or a full-sized bougie can be passed into the stomach without anything pathological being observed, it is a case of *hysterical dysphagia*.

5. Where gradually increasing dysphagia is associated with an increasing tumour in the neck or mediastinum, it should be attributed to the *pressure of the tumour*, unless there is strong reason to think that there is intrinsic disease of the part. The compressing tumour may be an aneurysm, a benign or malignant bronchocele, malignant growths in other parts, or masses of enlarged glands. There may be a primary malignant stricture of the gullet with secondary enlarged glands in the neck.

6. Gradually increasing and constant dysphagia with corresponding emaciation, where there is no evidence of any swelling pressing upon the part, indicates *stricture of the gullet.* If there is a history of syphilis and there are signs of gummatous disease of the pharynx, it is *syphilitic.* If there is a history of the swallowing of corrosive fluid, and the gullet is seen to be puckered in and the wall is pale, the stricture is *cicatricial.* Traumatic stricture may follow an ulceration caused by the impaction of a foreign body or by other injury to the part. If there is no history suggesting previous ulceration of the gullet, the disease must be regarded as *malignant stricture.* The age of the patient, the steady increase of the dysphagia, the rapid emaciation, and the presence of enlarged glands in the neck are confirmatory circumstances. The œsophagoscope will show an altered colour of the part, loss of elasticity, and unevenness or ulceration of the surface.

7. Severe pain and difficulty in deglutition coming on immediately after urgent vomiting, or the swallowing of a large or too hot bolus or a sharp fragment of bone, is due to a laceration or *abrasion of the gullet ;* these symptoms may last for some days, but gradually subside if only liquid or soft food is taken.

8. Where, immediately after very urgent vomiting, the patient becomes intensely collapsed and there is severe pain behind the sternum, *rupture of the œsophagus* has occurred. If the patient does not die in the collapse, signs of mediastinal suppuration come on.

9. Repeated hæmorrhages from the pharynx without obvious cause, such as aneurysm, ulceration, or malignant tumour, are probably due to *œsophageal nævus.* The blue veins can be seen by means of the œsophagoscope.

CHAPTER XXXII

DIAGNOSIS OF DISEASES OF THE TONGUE

As in all other cases of surgical diagnosis, before deciding upon the nature of any affection of the tongue, care must be taken to investigate the history of the case—whether congenital or acquired, of recent or more remote origin, rapid or slow in progress; the habits of the patient, particularly as regards irritation of the tongue by alcohol, tobacco, or the sharp edge of a tooth; and the evidences of previous disease or concomitant affections, especially syphilis and tuberculosis.

The investigation of the tongue itself should be conducted as follows:

1. The patient should be asked to open his mouth, and the surgeon should take note of the **size and form of the tongue.** The tongue may be considerably enlarged, so that it cannot be lodged within the mouth, or slightly enlarged and so compressed against the teeth as to be indented by them. On the other hand, the tongue may be absent altogether, or smaller than normal; it may be fissured or deeply scarred.

2. The patient should then be requested to protrude the tongue to the full, and the surgeon should notice whether it is protruded symmetrically and to the full extent. The patient should then be asked to turn up the tip of the tongue, and to move it from side to side, to show the freedom with which

these movements are carried out. The **mobility of the tongue** may be lessened by congenital malformations—tongue-tie, and defective development of the organ—by inflammatory and neoplastic infiltration of the extrinsic muscles of the tongue, by lessened elasticity of the mucous membrane passing from the tongue to the alveolus, the palate, and the larynx, or by paralysis of the muscles of the tongue. The movement of the tongue is unsymmetrical when either of these conditions is unilateral, or more intense on one side than the other.

3. Next observe the **surface of the tongue,** gently drying it with a clean handkerchief, if necessary. Note particularly its *colour,* whether livid or paler than normal: whiteness of the tongue (not "fur") indicates thickening of the epithelium; the presence or absence of *fur;* the condition of the *papillæ,* whether enlarged or absent; the presence of any other *irregularities* of the surface—cysts, veins, nodules, warts, or plaques—and the fact of *ulceration* or *fissure.* The foliate papilla at the side of the tongue, just where the anterior pillar of the fauces joins the tongue, is sometimes large and cleft; this must not be mistaken for disease. A careful comparison of the papillæ on the two sides of the tongue will prevent this error.

4. Then determine by sight and by touch whether there is any **tumour** on or in the tongue. The features of a tumour of the tongue to be specially studied are its position—whether on the surface or deep in the substance of the tongue; if on the surface, whether it is pedunculated or sessile, and if its covering is smooth or papillated. The consistence of the tumour, its limitation to the tongue, or extension to the jaw, palate, and tonsil, are to be noted.

5. If there is an **ulcer**, the following points should be noted :—

i. **History and associated conditions.**—Injury, whether from external violence, or from a sharp tooth or ill-fitting tooth-plate, is important ; so is a history of dyspepsia, of former similar attacks, or of syphilis. Note any signs of chronic glossitis, of tuberculous or syphilitic lesions, or of mercurial stomatitis.

ii. **Age.**—Children are subject to herpetic ulceration ; in early manhood syphilitic ulcers are frequent ; at and after middle age epithelioma becomes common.

iii. **Duration.**—Herpetic and dyspeptic ulcers are of short duration ; syphilitic ulcers are chronic ; epithelioma is steadily progressive.

iv. **Position.**—Gummatous, tuberculous, and dyspeptic ulcers are generally on the dorsum ; epithelioma, herpes, and syphilitic fissures are commonest at the edge ; chancre is generally near the tip ; mercurial ulceration is on the under-surface.

v. **Number.**—Herpetic, dyspeptic, secondary syphilitic, and tuberculous ulcers are usually multiple ; a primary chancre, a gummatous ulcer, and epithelioma are nearly always single.

vi. **Depth.**—Deep ulcers are the result of injury, gumma, or epithelioma.

vii. **Base and edge.**—Note whether the base is firm and infiltrated, sloughy or suppurating, irregular or fungating, and whether the edge is thick, everted, or undermined, or the seat of tiny yellow tubercles. The importance of these signs is the help they give in recognizing the condition that preceded the ulceration. Any ulcer, whether on the tongue or elsewhere, when chronic, may become indurated. Sloughing of the base of the ulcer is especially seen in syphilis ; a thin, slightly undermined edge is met with in tubercle; and just after a gumma has sloughed out the edge of the deep ulcer left is undermined. A firm and infiltrated base and edge are especially indicative of cancer.

viii. The **discharge** is purulent from tuberculous ulcers, often sanious and with a peculiar fetor in epithelioma. Salivation is a marked feature in all but the earliest stages of epithelioma and in mercurial ulceration. The discharge from primary and secondary syphilitic ulcers can be shown to contain the *Spironema pallidum*.

ix. The **teeth** should be examined to detect any sharp edge, or rough mass of tartar, opposite the ulcer. Any denture should be carefully felt to see if there is a projecting edge. At the same time the cleanliness or otherwise of the teeth and the presence of pyorrhœa will be noted.

6. **Examine the lymphatic glands.**—To examine these glands, stand behind the seated patient, place the finger-tips under the chin and pass them back beneath the horizontal ramus of the jaw to the angle of the jaw, then feel beneath the anterior border of the sterno-mastoid muscle from the skull to the clavicle, and carefully compare the two sides. Now, standing in front of the patient, place one finger in the floor of the mouth, and fingers of the other hand beneath the jaw, and examine the tissues between the two hands. This is the most exact way of examining the submaxillary lymphatic glands and also of determining whether an enlarged gland is or is not fixed to the bone; by this means small hard glands can often be recognized when they cannot be felt from outside. The lymphatics of the anterior part of the tongue pass into the glands beneath the jaw on the same side; those from the back of the organ pass into glands over the carotid sheath on both sides.

7. **Microscopical examination and blood test.**—In some cases it is necessary to examine microscopically the discharge from an ulcer for tubercle bacilli and for the *Spironema pallidum.* Occasionally it is well to cut out a portion of the edge of an ulcer or an entire nodule and to examine it for evidences of downgrowth of epithelium, and cell-nests. Wassermann's test may be used to confirm the diagnosis of a late syphilitic lesion.

8. **Effects of treatment.**—In some cases the result of treatment is so striking that it establishes the diagnosis at once. For instance, the removal of a jagged tooth or an ill-fitting plate may be followed in a few days by the healing of an ulcer, showing that it is traumatic; or the administration of iodide of potassium or of salvarsan may cause the rapid disappearance of a syphilitic lesion. It must be borne in mind, however, that iodides often cause an improvement in malignant growths; this must not be confused with the entire healing of a syphilitic lesion.

NON-ULCERATIVE AFFECTIONS OF THE MUCOUS MEMBRANE

1. A milk-white deposit on the tongue, which can be scraped off, leaving the surface a little raw, and which under the microscope shows spores and fibres of *Oïdium albicans*, is **thrush.**

2. Slightly raised patches of mucous membrane having a pale-blue opalescent appearance are **mucous patches.** Find the *Spironema pallidum* and look for other evidences of syphilis.

3. A pale-pink rash in rings or crescentic patches, spreading rapidly over the surface of the tongue, leaving the mucous membrane smooth and deep red in colour, without pain, ulceration, or salivation, and quite uninfluenced by treatment, is **annulus migrans.**

4. A black discoloration of the dorsum of the tongue, which is not removed by gently wiping the surface, is **nigrities linguæ.**

5. If the surface of the tongue has lost its papillæ and is red, smooth, with a glazed appearance, it is in the early stage of **superficial glossitis.** This is often spoken of as the "smooth glazed tongue."

6. If the surface of the tongue is devoid of papillæ and white in colour, it is in a later stage of **superficial glossitis**, and the condition is called **leucoplakia.** When the epithelium is heaped up in uneven warty masses with wrinkles and furrows—a more advanced stage still of the same disease—it is known as **ichthyosis linguæ.** This disease may affect a part or the whole of the papillary surface of the tongue, and the various stages may coexist. The destruction of the papillæ, followed by more or less thickening of the epithelium, is the characteristic feature of the disease. It is liable to recurring attacks of ulceration, and especially to the development of epithelioma.

7. When a patch of leucoplakia becomes warty or ulcerated, and the edge and base of the ulcer are felt to be firm, and especially if at the same time the submental glands are enlarged, the disease is now **epithelioma.**

8. If the surface of the tongue is puckered, or depressed along interlacing lines, and in these lines or puckerings firm bands are felt, the condition is **syphilitic sclerosis.** The sclerosis is deep and involves the muscular tissue of the tongue; it may leave the mucous membrane quite healthy.

9. A pink or whitish projection from the surface of the tongue with a finely papillated surface is a **papilloma.** The surface is not ulcerated; there is no induration beneath or around its base; it may be pedunculated. Most common on the dorsum of

the tongue, it may also be found on its under-surface. It may occur at any age.

10. A tiny nodule on the side or tip of the tongue which does not consist wholly of an outgrowth from its surface, particularly if its colour and its surface differ from that of the surrounding papillæ, is to be regarded as an **epithelioma**, and should be widely excised and then examined microscopically in serial sections.

Ulcers of the Tongue

1. If the ulcer is quite superficial, painful and tender, looking sharply punched-out, and especially if multiple, situated on the sides and tip, and there are similar ulcers on the lips or cheeks, it is **herpes.** Herpetic ulcers commence as small white blisters, run a rapid course, and are accompanied by slight salivation.

2. A recurring superficial circular or oval ulcer on the dorsum of the tongue, with a smooth base, free from induration, and without glandular enlargement, is probably a **dyspeptic** ulcer, and the surgeon must inquire for symptoms of indigestion.

3. If the ulcer is situated on the side of the tongue, is ragged, deep, and irregular, without induration of its edge or base, and is opposite a mass of tartar, or an angle of a tooth, or the edge of a "plate," it is a **traumatic ulcer.** This diagnosis will be confirmed if on removing the local irritation the ulcer heals up. The glands are not enlarged.

If traumatic ulcers persist for some time the edge and base may become thickened to a limited extent. They can then be distinguished from epithelioma only by the beneficial effect of removal of the local cause and by the absence of glandular enlargement. A traumatic ulcer may become epitheliomatous.

4. If the tongue is swollen and there is saliva-

tion, with great fetor of the breath, and along the under-surface of the tongue and at the tip there are irregular superficial ulcers with greyish base, while the gums are swollen, softened or ulcerated, and receding from the teeth, it is a case of **mercurial ulceration.** The knowledge that the patient is exposed to the influence of mercury in some form will establish this diagnosis.

5. A single ulcer of recent origin near the tip of the tongue, with marked induration of the edge and base, and induration and swelling of several glands beneath the jaw, is probably a **chancre.**

6. A superficial crack or fissure on the side or tip of the tongue, multiple, chronic, or relapsing, is probably **syphilitic ulceration.**

7. Shallow sinuous fissures on the dorsum of the tongue, the intervening mucous membrane being healthy, are **syphilitic.**

8. If an ulcer on the dorsum of the tongue is deeply excavated, with a greyish, dirty, sloughy base, and if the history shows that there was at first a hard lump in the tongue which softened and burst, it is probably an **ulcerated gumma.**

The diagnosis of chancre and of secondary syphilitic ulcers is made certain by finding the *Spironema pallidum* in the discharge. The diagnosis of the ulcerated gumma is established by obtaining a positive Wassermann reaction and by the effect of treatment.

9. If a painful ulcer on the tongue is superficial, has a thin, undermined edge, and a pale, shreddy base, without surrounding induration, a **tuberculous** ulcer must be suspected. If the patient shows signs of phthisis, or if a scraping from the sore contains tubercle bacilli, this diagnosis becomes certain. The ulcers may be single or multiple, and may be found on the palate and fauces as well as on the

tongue. Little yellow tubercles may be seen in the mucous membrane near the ulcer.

10. If an ulcer on the tongue of a middle-aged or elderly person has a firm base, thick or everted edge, and an irregular warty surface with a foul watery discharge, and there is enlargement of one or more of the lymphatic glands, it is an **epitheliomatous** ulcer. These ulcers are more common in men than in women, and are generally seated on the side of the tongue. They often extend into the floor of the mouth or on to the palate or gums. Even at an early stage there may be interference with the movement of the tongue, shown by deviation of the tip of the protruded organ to the affected side. As they spread (and their growth is continuous) they interfere more and more with the movements of the tongue, and may bind it down to the floor of the mouth or to the jaws. The disease usually begins in a crack, a wart-like papule, a blister, or in leucoplakia, and it may arise in the wall of a late syphilitic or of a traumatic ulcer.

TUMOURS OF THE TONGUE

1. If a tumour is congenital in origin, livid or bright-red in colour, compressible, not fluctuating, it is a **nævus.** The diagnosis of this condition is usually quite obvious.

2. A branched villous growth from the surface of the tongue without any induration or swelling of the tongue itself is a **wart** or **papilloma.**

3. A pendulous or pedunculated firm growth, of rounded outline, and covered with smooth, healthy mucous membrane, is a **fibroma.**

4. A firm infiltrating tumour growing rapidly in the substance of the tongue, painless, and not causing trouble except from its size, is probably a **gumma.**

This diagnosis is made certain if there is a positive Wassermann reaction, and antisyphilitic treatment is quickly curative. The tumours may be superficial and small, or seated in the muscular substance of the tongue, where they attain a larger size. They have a tendency to soften, and may fluctuate, and later still ulcerate.

5. If a nodule appears on the side or tip of the tongue, is felt to be in the mucous membrane and not merely a projection from its surface, and is firm, and has been noticed to grow, it is an **epithelioma.** If a nodule appears in or at the edge of a long-standing patch of leucoplakia, or around an ulcer in such a patch, it is an epithelioma. A lump on the side or tip of the tongue, even of some size, infiltrating the muscle, firm, with no tendency to softening, and with merely an abraded surface, is an epithelioma. In every case the diagnosis is confirmed if the associated lymphatic gland is enlarged.

Epithelioma of the pharyngeal part of the tongue occurs as a firm infiltration which later on ulcerates; it very early interferes with the mobility of the tongue, but is apt to be overlooked until far advanced.

In all cases of doubt in the diagnosis, the whole nodule or ulcer, or a sufficient portion of its edge, should be excised. Serial sections of the part removed should then be examined under a microscope.

The essential features of lingual epithelioma are that the disease (i) always involves the mucous membrane, (ii) spreads into the muscular substance of the tongue, (iii) ulcerates on the surface, sometimes deeply, and (iv) infects lymphatic glands.

6. Other and rare solid lingual tumours are lipoma, enchondroma, plexiform neuroma, and sarcoma.

7. If a fluctuating tumour is found in the substance of the tongue, and there is a history of

njury, and if the surrounding tissues are swollen or tender, it is an **abscess.**

8. If a fluctuating tumour is quite superficial, growing from the mucous membrane, of a bluish opalescent appearance, and painless, it is a **mucous cyst.** If it is too small to give the sense of fluctuation, the diagnosis must be made from the globular outline, translucent appearance, superficial position, and the absence of all signs of inflammation.

9. If a very chronic, tense, globular, fluctuating tumour is found in the tongue, deeper than a mucous cyst, and without signs of inflammation, and the eosinophile blood-cells are found to be increased in number, it may be diagnosed as a **hydatid cyst.**

General Enlargement of the Tongue

This condition is due either to macroglossia or to acute glossitis. If it is a chronic affection, congenital or noticed soon after birth, and the tongue is large, uneven on the surface, with enlarged papillæ, and small rounded glistening elevations formed by dilated lymphatics, it is **macroglossia.** The tongue may attain a very large size; the exposed part is then hard and dry, and its surface may be fissured and ulcerated, while the lower jaw is deformed by the pressure of the mass. Such a tongue is liable to recurring attacks of inflammation.

If the swelling of the tongue is acute, attended with pain and much distress from dyspnœa, dysphagia, and fever, and the surface of the organ is livid and indented by the pressure of the teeth, it is **acute glossitis.** This may be limited to one half of the tongue; if fluctuation can be detected in the swollen organ it indicates an *abscess.* The disease may arise from injury and infection, mercurialism, iodism, cold, and other less understood causes.

CHAPTER XXXIII

DIAGNOSIS OF DISEASES OF THE NECK

The surgical affections of the neck may be grouped under the following heads:

Swellings—Acute
Chronic { Fluid
Solid
Pulsating
Fistula.
Conditions giving rise to rigidity.
Enlargements of the thyroid gland.

The *lymphatic glands* of the neck are especially liable to disease. The diagnosis of diseases of glands has been discussed in Chap. XVIII.

1. **Acute swellings of the neck** are, with the rare exception of that produced by emphysema (p. 130), inflammatory in their nature. The surgeon must endeavour to discover the seat of the inflammation, and whether suppuration or sloughing has occurred.

i. If the swelling is in the position and has the outline of a lymphatic gland, and is painful and tender, and there is not much surrounding œdema, it is an **inflamed lymphatic gland**; if fluctuation is obtained in such a swelling, it is an acute **glandular abscess.** A local source of infection should be sought, and if found it corroborates the diagnosis.

ii. If the swelling occupies one side of the neck, and the head is inclined to the same side, and attempts to rotate it cause pain, while the inflamed part is very painful, ill defined, and tense, it is to be diagnosed as **cellulitis** beneath the sterno-mastoid muscle, and if the superficial parts are œdematous and glossy, and a fortiori if there is deep fluctuation, abscess beneath the muscle is to be diagnosed. It is important to detect suppuration at once, and increasing swelling, tension, marked superficial œdema, and fever warrant an incision, even in the absence of fluctuation. Cellulitis in any other part of the neck will be recognized by the same characters.

iii. If the swelling takes the form of a hard collar-like induration, extending between the jaw and the hyoid bone, pushing forwards the skin of this region, and raising and fixing the tongue, it is to be diagnosed as **angina Ludovici**; this swelling may come on very rapidly, and quickly lead to œdema glottidis, or to sloughing of the cellular tissue, and fatal blood-poisoning. When first seen there may be a sinus in the floor of the mouth leading into the sphacelated tissue. It is only when this form of cellulitis is idiopathic that it claims the above name. It may be traumatic from injuries or operations in the mouth, or it may be an extension from inflammation of the glands of the part.

iv. If the swelling consists of an ill-defined area of the skin and superficial fascia which is livid-red in colour, brawny in consistence, very painful and tender, and on the surface are seen small vesicles, or several small apertures in the skin exposing a soft grey slough, it is a **carbuncle**. This disease may be met with at any part, but is most common at the back of the neck. Carbuncles vary much in their rate of progress; they are usually single. They mostly occur in middle-aged plethoric individuals, and particularly in those suffering from glycosuria.

v. If the swelling consists of a hard flat or conical elevation of the skin, deep red in colour, clearly defined, painful and tender, on the summit of which a small pustule forms, which bursts and discloses a greenish slough of the deeper parts of the skin and perhaps also of the subcutaneous tissue, it is a **furuncle.** Furuncles are generally multiple, and, although very common on the back of the neck, are often widely distributed over the body. The "flat" or "blind" boil is sometimes distinguished from the more prominent "conical" or "ordinary" boil.

vi. If the swelling originates in a dark vesicle, beneath which a dry slough quickly forms, fresh vesicles appearing around it and in turn developing slough beneath them, the fluid in one of the vesicles should be examined for *Bacillus anthracis*, and if found the diagnosis of **anthrax** is certain. There may be no constitutional symptoms when the case is first seen, as these follow the local condition at an interval of two or three days (*see also* p. 415).

2. **Chronic fluid swellings of the neck** are either abscesses, cysts, or softened malignant growths. Note particularly the position of the swelling, its depth, the parts to which it is adherent, its tension, its outline, the coexistence of any solid growth or swelling or disease in neighbouring structures. The age of the patient, the duration of the swelling, and its mode of onset and progress are other facts of importance.

i. If the swelling is in the position of a lymphatic gland, is of low tension, fixed to the surrounding parts, has followed upon a solid lump, or if a solid part of the swelling can be felt deep to the fluid part, it is a chronic **tuberculous glandular abscess.** The presence or history of other tuberculous glands or abscesses will confirm the diagnosis. As the abscess approaches the surface the skin over it becomes reddened. But careful examination will prevent the error of diagnosing the condition as an acute pyogenic abscess.

ii. If the swelling is deep in the neck, immovable over the spine, and it can be felt bulging forwards to the pharynx, it is a **chronic retropharyngeal abscess.** These abscesses may point behind the upper part of the sterno-mastoid muscle, or in front of the lower end of the muscle close above the sternum. The signs of caries of the cervical spine will usually be present (*see* p. 402).

iii. If in a patient with caries of the upper dorsal spine a fluctuating swelling gradually makes its appearance at the lower part of the neck, pointing either in front or in the supraclavicular triangle, it is a **thoracic spinal abscess.**

iv. If the tumour is fixed to the skin, freely movable over all the deeper structures, tense, globular in outline, and very chronic in its course, it is a **sebaceous cyst.**

v. If the tumour is in the middle line of the neck, fixed either to the hyoid bone or larynx, and is not attached to its superficial coverings, it is a **thyroglossal-duct cyst.** These are most commonly found just below the hyoid bone, as small tense cysts; they are met with in young persons.

vi. If the tumour is at the side of the neck beneath the sterno-mastoid muscle, has a well-marked outline, has grown very slowly and painlessly, and is opaque, it is a **branchial dermoid cyst.** If tapped the cyst is found to contain grumous fluid. If the cyst arises from the highest branchial groove it projects in the mouth beneath the side of the tongue and in the submaxillary triangle of the neck. (*See also* p. 433.)

vii. If the swelling is congenital, and projects as a translucent very thin-walled cyst in the neck of an infant or young child, it is a **lymphatic cyst,** or hydrocele of the neck. If the swelling is tapped, clear serous fluid escapes.

viii. If the swelling is congenital, situated close to the carotid sheath or in the posterior triangle, and it is fixed to the surrounding deeper structures, and is partly fluid and partly solid, it is a **cystic hygroma.** These swellings are very prone to attacks of acute inflammation.

ix. If the swelling began as a solid lump, which has been observed to enlarge and to become soft and fluctuating, is firmly adherent to the surrounding tissues, and the patient is a middle-aged or elderly adult, it is a softened **malignant tumour.** Evidence of a primary growth in the mouth, pharynx, or œsophagus will corroborate this diagnosis. These growths will sometimes fluctuate throughout and closely resemble a chronic abscess, the solid growth consisting of only a thin enveloping layer, and if the skin over the swelling is reddened the diagnosis may be difficult. The age of the patient, often the livid-mottled appearance of the skin over the swelling, and the absence of redness and œdema beyond the fluctuating area are distinguishing features.

x. For thyroid cyst, *see* p. 465.

3. **Chronic solid swellings of the neck.**—i. A small swelling in the middle of the sterno-mastoid of an infant is **hæmatoma of the sterno-mastoid,** caused by partial rupture of the muscle at birth.

ii. A firm swelling in the posterior triangle, fixed to the spine and passing forwards beneath the lower end of the sterno-mastoid muscle, lying deep to the subclavian artery, is a **cervical rib.** A skiagram will show quite clearly the nature and relations of the swelling.

A cervical rib is very rarely discovered before puberty; it is usually detected either in a routine examination of the neck or in searching for the cause of sensory or motor disturbances in the hand in the area of the eighth cervical nerve.

iii. A soft lobulated swelling with a clear outline and enjoying some degree of mobility in the tissues is an **encapsuled lipoma.** Such a tumour may be in the subcutaneous tissue, and in that case it is usually globular or ovoid in outline, and projects prominently from the surface. It may lie deep to the cervical fascia, in the posterior triangle, or, if congenital, be attached to muscle or even to the clavicle or spine.

iv. A globular swelling over the mastoid process or beneath the jaw, lying in and fixed to the subcutaneous tissue, so that it does not glide under the skin and over the deep fascia, is a **diffuse lipoma.** Such a swelling may be symmetrical; or it may form either a "double chin" or a massive collar all round the upper part of the neck.

v. A rounded swelling in the submaxillary triangle, single, and not lobulated, easily felt as close under the mucous membrane in the floor of the mouth, and in many cases having a definite groove along its posterior border, is an **enlarged submaxillary lymphatic gland.** If subacute in its onset, it is the result of infection of the gland, with or without calculus-formation in the duct. Pressure upon it, whilst the orifice of Wharton's duct is carefully observed, will result either in no flow of saliva or in the appearance of purulent fluid in place of clear saliva. If chronic in its course, it is a chronic inflammation of the gland. If of very slow growth and uneven on the surface, it may be a **mixed tumour** of the gland.

vi. A firm tumour of slow growth deep to the sterno-mastoid muscle at the level of the thyroid cartilage in a middle-aged person, having its long axis transverse, tending to project both in front and behind the muscle, and perhaps pushing forwards the carotid artery, is a **tumour of the carotid body.**

vii. If the tumour is rapidly growing, firmly fixed to the surrounding tissues, with a more or less ill-defined outline, it is either a gumma, actinomycosis, or a malignant tumour. If there is a clear history or other evidence of syphilis, and the skin has ulcerated and exposed a tough yellow-grey slough, or the tumour quickly disappears under antisyphilitic treatment, it is a **gumma**; the neck is not a frequent seat of gumma. If, however, the infiltrating swelling exhibits a tendency to soften in several places, or has formed two or several sinuses, examine the discharge for streptothrix, and if it is found it demonstrates that the case is one of **actinomycosis.** These tumours often closely simulate a malignant growth. If the tumour grows rapidly, is markedly infiltrating, and either remains solid throughout or softens down at one place, it may be recognized as a **malignant tumour.** Malignant growths in the neck are often very firm, but they may soften into a "spurious cyst," or ulcerate or fungate. It is often impossible to distinguish, apart from microscopical examination, whether the tumour is sarcoma or carcinoma; its primary or secondary nature and the exact seat of origin may assist in this step in the diagnosis.

viii. For lymphadenoma, lympho-sarcoma, and other diseases of lymphatic glands, *see* p. 266.

ix. If a swelling which encroaches upon the lower part of the posterior triangle of the neck is found to be soft, elastic, crepitant under the fingers, resonant on percussion, varying in size with respiration, and distended by coughing, it is a **pneumatocele** or hernia of the lung. (*See also* p. 149.)

4. **Pulsating tumours of the neck** form an important class. The surgeon must first of all decide whether the pulsation is inherent in the tumour or only transmitted to it, and, if the former, whether the tumour is an aneurysm or a vascular growth. The swellings liable to be mistaken for an aneurysm are pulsating bronchocele, simple or cystic bronchocele lying over the carotid artery, and dermoid cyst or abscess over the carotid artery. A study of Chap. XX. will enable the surgeon to distinguish these various swellings with certainty. But it may be here pointed out that bronchoceles move with deglutition, aneurysms do not. A pulsating abscess or cyst fluctuates readily, but is not reducible by pressure when the artery is compressed on the cardiac side of the tumour.

When the surgeon has decided that a given pulsating tumour is an **aneurysm**, he must determine from which artery the tumour springs. When occurring in the upper carotid triangle it will be at once recognized as a **carotid aneurysm**; if limited to the posterior triangle it is equally easy to diagnose a **subclavian aneurysm**; but when the aneurysm is placed at the root of the neck in front it may be difficult or impossible to determine this point. The surgeon should learn, if possible, where the tumour first appeared: if between the two heads of the sterno-mastoid on the right side, it is probably an **innominate aneurysm**; if internally to the sternal head, it is probably a **carotid aneurysm**; if externally to the interval, it is probably a **subclavian aneurysm**; this sign is not absolutely decisive, and an accurate history can rarely be obtained. He must then study the pulse in the arteries beyond the aneurysm, comparing it with those in the same vessels of the opposite side. If the pulse in the carotid artery and its branches is unaffected, it shows that the aneurysm is neither innominate nor carotid ; similarly, if the subclavian or brachial pulse is unaffected, it shows that the aneurysm is neither innominate nor subclavian, and vice versa. The pulse in these arteries may be weakened or lost by the tumour involving the parent trunk, by its occluding the mouth of the artery, by some portion of the sac compressing the vessel, or, lastly, by a portion of clot plugging the vessel. Aneurysm of the arch of the aorta may extend up into the root of the neck. A good skiagram will be of very great assistance by showing clearly the position, extent, and relations of the aneurysm.

In aneurysm at the root of the neck the surgeon must carefully notice whether there is dyspnœa or respiratory stridor (from pressure either upon the trachea or upon the recurrent laryngeal nerve), dysphagia from pressure upon the œsophagus, or a small contracted pupil, narrow palpebral fissure, and loss of prominence of the eyeball, from pressure upon the sympathetic. Pressure upon the recurrent laryngeal nerve will be shown by paralysis of the abductor muscle of the same side and fixity of the vocal cord in the cadaveric position. In pure tracheal stridor and dyspnœa the larynx is immovable and the vocal cords will be seen widely abducted with each inspiration ; the two forms of respiratory difficulty may coexist, and it is very important to remember this when contemplating opening the trachea to relieve laryngeal obstruction.

Paralysis and wasting of the muscles of the same side of the tongue often occur in carotid aneurysm, from pressure on the hypoglossal nerve.

5. **Fistulæ and sinuses.**—By studying the his

tory of the case and noticing the position of the orifice, the direction of the sinus, and the nature of the discharge from it, a diagnosis of the various sinuses and fistulæ may be arrived at.

i. If the sinus opens in the middle line of the neck and runs up in front of the larynx towards or even up to the hyoid bone, it is a **patent thyro-glossal duct.**

ii. If the sinus opens at the anterior border of the sterno-mastoid muscle in the upper half of the neck and passes towards the pharynx close to the carotid sheath, it is a **branchial fistula.** If the sinus is known to be congenital, or opens under a little pendulous fold of skin—a rudimentary pinna—or the discharge is mucous, or if while the patient is swallowing fluid some of it escapes through the sinus, the diagnosis is readily made. A branchial fistula may be found in the tragus or helix of the pinna.

iii. If the sinus originated in an abscess, and its track passes upwards towards the jaw, careful examination of the teeth should be made, as it is almost certainly a sinus left by a **dental abscess,** or due to **necrosis of the mandible.** A dental abscess may point at a considerable distance from the jaw.

iv. If a sinus or sinuses lead into a mass of infiltrated tissue and discharge pus, look for sulphur-like grains in the pus, and with the microscope search for the fungus of **actinomycosis.**

v. If the sinus leads down to a chronically enlarged gland and discharges thin flocculent pus, it is a **tuberculous glandular sinus.**

vi. Tracheal fistula, sinuses left by retropharyngeal abscesses, and by ruptured sebaceous, dermoid, or thyroid cysts, may be met with in the neck.

6. **Rigidity of the neck** is a symptom which accompanies an important group of diseases. The

head may be fixed in the upright position, or it may be inclined to one or other side.

i. If the head is drawn down and rotated so that the chin is turned towards one shoulder and the occiput towards the other, and one ear is approximated to the clavicle, while the neck on that side is hollowed, and on the other convex, the deformity is known as **torticollis, or wry-neck.** In many cases the deformity is *congenital,* and in these the face on the contracted side develops less than on the other, the eyes become oblique, and the cervical spine curved. If *acquired,* search must be made for its cause. In children, painful inflamed glands may be found beneath the sterno-mastoid muscle, or there may be a history of such; these cases may be distinguished as *inflammatory.* In young women torticollis is met with as a result of *hysteria;* in this form the muscular spasm may vary from time to time, subside altogether at intervals, and even change sides. When any attempt at movement causes severe pain, and especially when neither of the above causes is present, suspect *caries of the spine.* (*See* p. 468.) When the head is from time to time jerked into the position of wry-neck from clonic spasm of the sterno-mastoid muscle, it is distinguished as *clonic or spastic torticollis.* Care should be taken to notice what muscles, if any, besides the sterno-mastoid are involved in the spasm.

ii. If the head is fixed upright, or but slightly inclined to one side, or with the chin poked forwards, the surgeon has to diagnose whether the condition is dependent upon **disease of the spine,** or is **muscular rheumatism.** The history of the case will show whether the rigidity and pain came on gradually or suddenly, followed on injury or exposure to cold, and attention should be paid to the character of the pain, to its exact seat, and whether it is increased at night, or relieved by friction and warmth. The examination should be conducted with gentleness and care. The patient being seated, the surgeon should place his hand flat on the top of the head, and gently press it vertically down, graduating the pressure, and watching for any expression of pain. Then, grasping the head, with one hand under the chin and the other below the occiput, he should steadily lift it, and ask whether that relieves the pain or not. Grasping the head again at the sides, he should gently rotate it to either side and make it nod to and fro, and also notice whether and when rotation causes any pain. A careful examination of the spine should be made with a view of detecting any undue prominence of the cervical spinous processes or thickening around them, and the pharynx should be examined for retropharyngeal abscess. An abscess or sinus in any other situation of the neck will be noticed.

A skiagram of the cervical spine should be carefully studied for evidence of disease in the bodies of the vertebræ or in the joints of the atlas and axis.

If the pain and stiffness have come on suddenly, or after exposure to cold, or an attack of influenza, and if they are found to be relieved by heat and by gentle friction, while gently raising or depressing the head on the spine does not give pain, the condition is probably that to which the name **muscular rheumatism** or **fibrositis** is given. The surgeon should then learn which active movements are most painful to the patient, and if he finds that these very movements when passive are not painful, but that the opposite ones are, and if there is no change in the bones to be seen in the skiagram, nor sign of abscess, nor protrusion of any of the cervical spines, this diagnosis will be established. If, for instance, a patient complains that he cannot actively extend the head without pain, but the surgeon finds that he can passively place the head in the extended position without pain, it demonstrates that the pain in the former case is not due to the position but to the agent, the muscle. Further, a muscle whose contraction is painful cannot be stretched without giving pain, and therefore, when the head is well bent forwards so as to put these extensor muscles on the stretch, pain will be caused. The same phenomena are observed in cases of "rheumatism" of the rotator muscles of the spine.

Where, however, the surgeon finds that the pain and rigidity have come on gradually, that the pain is worse in the latter part of the day and is exaggerated by all movements, that pressure of the head down upon the spine gives pain, while raising the head relieves the pain or removes it altogether, and that the skiagram shows thinning and blurring of the shadow of one or more vertebræ, or actual loss of substance and deformity, he must diagnose **tuberculosis of the spine.** Should there be protrusion of the spine behind, swelling over the spine, or an abscess behind the pharynx or in the posterior triangle of the neck, the diagnosis will be rendered still more obvious. (*See also* p. 402.)

7. **Enlargements of the thyroid gland.**—A swelling of the thyroid gland is recognized by its position, by its shape, and by the fact that it moves with the trachea in deglutition. It must not be forgotten that aberrant thyroid tumours may be met with on the side of the thyroid cartilage or beneath the outer edge of the sterno-mastoid muscle, and that thyroid tumours may extend into the superior mediastinum. In studying a thyroid swelling, notice particularly its history, duration, mode of onset,

and rate of growth, its outline, especially whether it involves a part or the whole of the gland, its mobility on the muscles, vessels, and bones of the neck, its consistence, the presence of pulsation in the swelling, and the presence of symptoms of hyperthyroidism, if any.

i. If the swelling of the thyroid gland has developed abruptly and rapidly, is painful and tender, and the parts covering it are hot and reddened, and the general temperature is raised, it is a case of **acute thyroiditis.** If the coverings of the gland are œdematous, or fluctuation can be felt in the swelling, it is an *acute thyroid abscess.* This disease may arise in the course of a case of enteric or other infective fever.

ii. If there is a chronic enlargement of the whole thyroid gland, more or less uniform and symmetrical, soft, at the most only slightly uneven on the surface, and the swelling moves freely in the neck, does not pulsate, and there are no symptoms of thyroidism, it is a **parenchymatous bronchocele.** More rarely such a bronchocele may be quite firm, and is then liable to cause dyspnœa on exertion by pressure upon the trachea.

iii. If the thyroid gland is generally enlarged, is soft and pulsating, and there are signs of hyperthyroidism such as tachycardia, palpitation, tremors, proptosis, inco-ordination of the associated movements of the eyeball, eyelid, and brows, wasting, sweating, etc., it is a case of **Graves's disease, or exophthalmic goitre.**

iv. If there is a steadily increasing swelling of the thyroid gland, which, beginning in one lobe, has infiltrated the entire gland, and then spread beyond the gland into the surrounding tissues, fixing it to them, it is a **malignant bronchocele.** The fact of the growth extending through the capsule of the gland is the main point upon which the diagnosis rests; hardness of the growth is a suspicious sign. Later on, the uneven nodular outline, ulceration, signs of pressure upon the trachea and œsophagus, inferior laryngeal nerve, and jugular vein, and secondary growths in glands or bones, especially the calvarium, render the diagnosis very apparent.

v. If the swelling involves a part only of the thyroid gland, or if, the entire gland being enlarged, it can be made out that it is by the concurrence of two or more separate swellings in the gland, and if the swelling moves freely in the neck, it is **thyroid adenoma** or **adenomatous bronchocele.** The adenoma may be solid or cystic, or a combination of the two: when solid it may be so soft as to simulate a fluid one. Some cysts are so tense, or so deep, or so small that their fluid nature cannot be identified. Where fluctuation is distinct it may be called a **cystic bronchocele.** The clearly circumscribed ovoid or globular outline of the tumour or tumours distinguishes adenoma from other forms of bronchocele.

CHAPTER XXXIV

DIAGNOSIS OF DISEASES OF THE BREAST

The importance, and often the difficulty, of correct diagnosis of affections of the breast are so generally recognized that it is not needful to insist upon those facts here. It may be well to impress upon the student the necessity of bearing in mind the physiological changes occurring in this gland. The earliest of these is the slight engorgement, with consequent swelling, slight tenderness and induration, that may be observed a few days after birth, often more marked in male than in female children. In this state inflammation is readily set up by injudicious friction, and abscess may result. In girls at puberty the gland usually undergoes a considerable but variable degree of enlargement, the nipple develops and the areola becomes broader and better marked. The commencement of this change, particularly if it occurs on one side earlier than on the other, may be mistaken for the development of a tumour, but a proper examination will exclude the error, and a consideration of the patient's age will at once suggest the true nature of the case, which will be further cleared up by time. At or soon after this period it is not uncommon to see acute suppuration under the skin of the areola or that covering the mamma proper. In males at this age there is often noticed an abortive development of the gland, giving rise to a small, firm, disk-shaped swelling under the nipple, which may be a little tender to pressure. A knowledge of this fact will prevent any error of diagnosis; the swelling is not always bilateral, and, if bilateral, not always symmetrical.

The full evolution of the gland only occurs during pregnancy and lactation, and is followed by a corresponding involution. The only one of these changes that requires mention here is the formation of small, firm, rounded nodules caused by the full development of the acini of the gland; the distinctness with which these are to be felt increases towards the end of pregnancy, and varies with the amount of fat around the lobules or under the skin. Simple tumours may originate at this period, but cancer only rarely. Occasionally abscess is met with in a lobe of the gland during pregnancy. During lactation inflammatory troubles and abscess become very frequent; and rapidly growing carcinoma is occasionally seen at this time.

At the climacteric the gland undergoes extensive involution; the acini become smaller and eventually disappear. It is during this period of involution of the gland that cysts and cancerous tumours most frequently develop.

EXAMINATION OF THE BREAST

The patient should be seated on a chair before a good light, the shoulders well supported. The surgeon should then examine the parts in the following order: (1) The nipple, (2) the areola, (3) the skin over the breast, (4) the gland itself, and (5) the lymphatic glands.

1. **Examine the nipple,** noticing its *position,* whether displaced in any direction, and, if so, whether it is drawn towards, or pushed aside by, a lump or swelling; its *size,* whether large, small, or rudi-

mentary; its *shape*, whether prominent, flattened, inverted, or retracted, and whether it is bound down to any part of the gland; its *surface*, whether inflamed, discharging, ulcerated, covered with scabs, or dotted over with firm bright specks; and whether there is any *discharge* from its ducts—milky, serous, or bloody—and if the discharge is made to flow by pressure upon any particular part of the areola or breast. If the shape of the nipple is abnormal, inquire whether it is a malformation or an acquired deformity: *malformations*, especially retraction and inversion, may cause obstruction to the outflow of milk, milk-congestion, and mammary abscess; where *retraction* is *acquired*, it indicates a dragging upon the galactophorous ducts. If there is *discharge*, care must be taken to determine whether it flows from the ducts which open on the top of the nipple, or exudes from inflamed or ulcerated skin covering the ducts; this is decided by the presence of cracks or fissures, by the effects of compression of the gland, and by noticing whether the discharge flows from the top or the sides of the nipple.

2. **Examine the areola.**—During pregnancy and lactation the large sebaceous glands in the skin may form quite marked projections from the surface; these must not be mistaken for pathological appearances. Any redness or swelling of the part is to be carefully taken note of, as well as the presence of discharge or scales of any kind and the adhesion of the skin to a subjacent swelling. Sometimes *dilatations of the galactophorous ducts* can be recognized both by sight and by touch as smooth, soft, pyriform swellings under the thin skin of this region. *Abscess, sebaceous cyst, hard chancre, mucous patch, eczema, Paget's disease,* and *carcinoma* may be found in this situation.

3. **Examine the skin over the breast.**—Notice any change in its colour or texture, any discharge, swelling, œdema, pointing, puckering, or ulceration. Gently raise a fold of skin and try to glide it over the gland, and compare the ease with which this can be done on the two sides. Then gently take the breast between the fingers and thumb and try to move it under the skin, and notice any dimpling of the skin thus caused. Loss of the usual mobility of the skin over the gland is due to shortening or loss of elasticity of the suspensory ligaments of Cooper, resulting from their deeper ends being drawn upon by a contracting growth, or by an infiltration extending along them. This sign—dimpling of the skin—is therefore an exceedingly important indication of the nature of an underlying growth. The definite adhesion of the skin to the parts beneath may be caused by inflammatory infiltration or by the extension of a growth into the skin. The skin should also be carefully examined for any small nodules in it, and undue sensitiveness should be noted.

4. **Examine the mammary gland.**—First look at the breast and observe its *size*, whether smaller or larger than its fellow; its *shape*, whether normal, gathered in to itself, or misshapen; its *position*, whether displaced in any direction. In some cases the effect of disease is so closely like that of a surgica removal that the student may easily be deceived on the point. Then feel the breast with the palmar surface of the fingers pressed flat towards the ribs, and notice whether the consistence and "feel" of the gland is uniform, or whether there is a lump or mass which the flat fingers appreciate as differing in consistence from the rest of the breast: if so, we say there is a "*tumour*" in the breast. It

is very important to remember that the presence of a tumour must never be determined by what is felt when the breast is grasped *between* the fingers and the thumb; when examined in that way a healthy breast may give the sensation of a tumour. Only after the presence or absence of a tumour has been determined by the hand placed flat upon the breast must the gland be examined in any other way. If there is nothing that can be identified as a "tumour," feel carefully the consistence of the gland and note any fine nodular unevenness, such as would be caused by distended or enlarged acini, or if any part or the whole of the gland feels firmer than it should.

Then examine the *mobility of the breast* over the chest-wall. Get the patient to press the palms of her hands firmly together, and so to fix the pectoral muscles by putting them into strong contraction, then notice to what extent this limits the range within which the mamma can be moved. The healthy breast affords a ready standard of comparison; it will be found that fixing the pectoral muscle always limits to some extent the mobility of the mamma; but in cases where either inflammation or a growth has extended from the gland to the fascia over the muscle, the breast becomes as fixed as the muscle.

5. **Examine the lymphatic glands.**—The examination should be made with the patient sitting or standing, the arm partly abducted and held by an assistant, so that the patient's muscles are relaxed; the surgeon, sitting or standing in front of the patient, should pass his fingers to the top of the axilla and first gently feel all the tissues between the skin and the ribs as he passes his fingers down; and then a similar examination of the anterior, posterior, and outer walls of the space should

be made. The size, consistence, and fixity of the glands are the points to be noticed. Compare them with those in the opposite axilla. Do not mistake the edge of the pectoral muscle or a rib for an enlarged gland, nor a hard fixed gland or mass of glands for a rib; a more common error is to miss an enlarged gland by not exploring the whole axilla. It is very difficult to feel a small firm gland in a fat axilla, and a firm gland adherent to a rib may be very readily overlooked.

Having explored the axilla, stand behind the patient and examine the glands immediately below and above the clavicle, comparing carefully the two sides. It should be remembered that the axillary glands are enlarged during and shortly after lactation; they are also enlarged by inflammation of the breast or of the skin over it, and they may be the seat of disease quite independent of that in the breast, such as tubercle or lymphadenoma.

Tumour of the breast.—Having decided that there is a tumour in the breast, the surgeon should continue the examination to ascertain the following facts about it:

1. **Its relation to the gland.**—The first and most important fact to determine about any breast tumour is whether it is fixed to a part of the breast, or is merely lying within the gland but not adherent to it. Notice first the outline of the tumour, whether it is sharply defined or gradually fades off into the gland, and then, fixing the breast by pressing it against the chest-wall on either side of the tumour with the fingers of one hand, attempt to move the tumour with the other; sometimes by passing the fingers over the surface one can feel a tumour moving in the gland, or, on the other hand, can appreciate that it is absolutely fixed to it. It may, however,

be quite difficult to determine this very important point. While making this examination, notice the part of the gland in which the tumour lies. *All malignant growths, abscesses, cysts, and granulomata are inseparably attached to, and form part of, the gland;* fibromata and adenomata, on the other hand, if of any size, are encapsuled growths lying more or less loosely in the gland. This single observation, therefore, may at once narrow down the diagnosis very materially.

2. **Consistence of the tumour.** — Next determine whether the tumour is solid or fluid. Notice its outline, whether rounded and clearly defined, smooth, and uniformly tense, like a cyst; uneven on the surface, like a fibro-adenoma; flatter, firm, and only slightly nodular, like many cases of scirrhus. Feel carefully for fluctuation, or elasticity, bearing in mind that this may be very difficult to appreciate in very small or very tense cysts, in cysts lying deep in full mammæ, and in deep abscesses. A soft sarcoma may give a perfect sense of fluctuation. Where there is doubt whether a tumour is solid or fluid, it should always be punctured with an exploring syringe; if fluid is withdrawn the cavity should be emptied to determine whether, as a result, the tumour has wholly or only partially disappeared.

The firmness of carcinoma is one of its very important features, and the detection of a firm nodule or edge will often enable the recognition of a scirrhous growth in a larger area of chronic mastitis.

3. **Influence of the tumour upon the breast and surrounding tissues.**—Under this heading there are three distinct points:

(*a*) *Evidence of infiltration* in the fact of the tumour extending beyond the gland in which it arose into the fat around, the skin over, or the muscle beneath it. This infiltration is only seen in malignant growths and in certain cases of inflammation—it is therefore an extremely valuable aid to diagnosis. (*b*) *Contraction.* Many swellings as they enlarge displace the surrounding tissues; but with the development of most cases of scirrhus, contraction of the growth occurs, and, as the periphery of the tumour is always fixed to the tissue in which it grows, the contraction tells upon these tissues and so causes retraction of the nipple when galactophorous ducts are involved, or dimpling or more marked puckering of the skin over it; in some cases the whole gland is shrunken and drawn in towards the growth. To recognize that a tumour contracts as it develops is a most important step in diagnosis. (*c*) *Œdema.* Occasionally there is found a little œdema of the skin and subcutaneous tissue over a lump in the breast; it is evidence of inflammation, and may aid in the recognition of a chronic abscess.

4. **Evidence of infectivity.**—Carcinoma infects the axillary glands at a *very* early period; it is rare to meet with a case of scirrhus in which a careful examination of the axilla does not reveal at any rate some hardening and enlargement of a gland. The infected gland may be single, or there may be several enlarged glands more or less closely matted together. Evidence of the infective nature of the tumour may also be found in secondary nodules of growth in the skin over and around it, and later on in distant parts, such as the liver, lungs, ovaries, and bones.

5. The **shape of the tumour** should be noticed, whether globular or ovoid, squarish, lobed or finely lobulated.

Cysts and abscesses are rounded in outline; cancer is often cubical; fibro-adenomata are usually finely lobulated. Chronic mastitis may cause a swelling of one or more of the lobes of the breast, or it may have a very irregular outline.

6. **Number of the tumours.**—Cysts are often multiple, fibromata are frequently so; occasionally more than one chronic abscess may be found, very rarely is more than one primary scirrhous growth seen. There may be a simultaneous development of scirrhus in the two breasts.

7. The **history of the case,** including the sex and age of the patient, the occurrence of pregnancy, miscarriage, lactation, and the duration and rate of growth of the tumour, are all points to be carefully noted.

The part having been examined in this systematic manner, cases of mammary disease can be readily grouped as follows:

Cases of acute enlargement of the breast.
Cases of chronic disease other than tumour.
Cases of tumour of the breast.

The individual members of each group may be diagnosed by attention to the points about to be enumerated.

A. CASES OF ACUTE ENLARGEMENT OF THE BREAST

1. If in a nursing woman a lobe of the gland or the whole breast is swollen and firm, the surface being irregular owing to the distension of the glandular acini, the skin not reddened nor fixed to the gland, and the part not acutely painful or tender nor the body temperature raised, it is a case of **milk-congestion.** Examine the nipple carefully for any cause of obstruction to a duct or ducts. The axillary glands will be found slightly enlarged.

2. If the breast is acutely painful and tender, the skin over it bright red in colour, and the outline of the glandular tissue blurred by œdema, it is a case of **acute mastitis.** The temperature is raised, and there are the usual signs of inflammatory fever. The axillary glands are enlarged and tender.

3. If in such a case the swelling is "pointing," or is found to fluctuate, there is a **mammary abscess.** In the absence of these signs an abscess is to be diagnosed if the swelling has increased after the first, if the area of redness has extended, if the tension is great, if the pain has become throbbing, or if there is marked subcutaneous œdema.

4. If the breast is prominent, the skin stretched, and the nipple pointing, and if pressing the gland back against the chest causes pain and gives a yielding sensation as of fluid under the mamma, and particularly if there is a swelling at the axillary border of the gland, which becomes more tense and prominent when the gland is pressed back, the diagnosis of **submammary abscess** should be made.

Such an abscess may be acute or chronic. When acute it is secondary to mammary abscess or to a wound of the part. Chronic submammary abscess is either tuberculous or mycotic. Tuberculous abscesses are generally secondary to disease of ribs; actinomycosis in this situation appears to be always secondary to the disease in the lung. When in any case of mammary abscess pus is found pointing at the margin of the gland, or sinuses are here met with along which a probe passes deep to the gland, it is evident that submammary suppuration has occurred.

5. An acute swelling with redness of the skin, superficial œdema, and the speedy development of a fluctuating and pointing swelling, without enlarge-

ment and hardening of the mamma itself, is a subcutaneous or **supramammary abscess.**

6. If the breast has rapidly become enlarged and firm, and the skin over it is red and fixed to the gland, and the gland is fixed to the chest-wall, and the axillary glands are enlarged and firm, it is a case of **acute carcinoma.** The rapid swelling, the redness of the skin, and the accompanying pyrexia make the case closely resemble acute mastitis, and this mistake is almost invariably made at first, particularly when, as often happens, the patient is pregnant or nursing. The absence of softening, the detection of a nodule or some other irregularity of the surface, and the invasion of the skin and of the chest-wall are the signs to be particularly relied upon in the diagnosis. Later, the spread of the disease to the glands in the neck or to other parts makes the diagnosis only too plain. This form of the disease may run its entire course in three or four months.

B. Cases of Chronic Disease other than Tumour

1. If both glands are found to be unusually large, not painful, nor inconvenient except from their bulk and weight, and of normal consistence, the condition is **hypertrophy.** Remembering that, without overstepping the limits of health, the breast attains a great size in some women, this diagnosis must only be made when the glands have attained really excessive dimensions. Two forms are to be recognized, in one of which the gland is very loose, soft, and pendulous, while in the other it is firmer, tenser, and projects forwards. Hypertrophy is generally bilateral, but not always symmetrical; it is most common in young women, the growth starting at puberty.

2. When the nipple is red, painful, very tender, and sero-purulent fluid is found exuding from cracks or fissures, the condition is known as **cracked nipple**; ulceration is commonest at the tip and round the base of the part. When the watery discharge dries into thin yellowish scales, the skin beneath these being red and itching but not acutely painful and tender, it is **eczema of the nipple.** Small white projections on the top of the nipple are epithelial **plugs in the ducts.**

3. If there is a discharge of serous fluid from the nipple, determine by careful pressure with the finger-tip exactly the spot from which this secretion comes, and then feel very carefully for any small nodule; if such can be felt the case is one of **duct papilloma**; if no nodule whatever is to be felt the secretion is from a **dilated duct.** If, however, the discharge is always or occasionally blood, it points to the presence of a **duct carcinoma** (*see* p. 487).

4. If the skin is red, discharging a watery fluid which stiffens linen and dries into yellowish scabs, the condition is **eczema.**

5. A very chronic eczematous condition of the areola and surrounding skin is known as **Paget's disease.** The affected surface may be dusky in colour with dry adherent scales, or bright red and moist with a constant watery discharge. In either case, its area slowly but progressively enlarges. This peculiar condition of the surface of the breast is always to be considered as definite evidence of the presence in the breast of a carcinoma, although the clinical appearance of a "lump" in the breast may be delayed for months or even years.

6. If a part or parts of a breast feel firmer than normal, but do not give the sensation of a tumour when the flat hand is pressed upon the part, and

the skin is not at all dimpled over it, nor the mobility of the gland lessened, it is a case of **chronic mastitis.** The affected part may be uneven, from the development of small *cysts* within it. One or more of the glands in the axilla may be a little enlarged. This affection is common in women between 30 and 50 years of age; it may be very difficult to distinguish from early carcinoma, and it may be the starting-point of carcinoma. Chronic mastitis is often present in both breasts at the same time, and often attacks more than one part of a breast; but neither of these features is quite distinctive, as carcinoma may attack both breasts simultaneously or be multiple in one breast, and, further, it may develop in one of two or more areas of mastitis. Mastitis is less sharply defined than scirrhus, and does not feel so distinctly a nodule in the gland. In many cases mastitis yields rather quickly to treatment by firm compression; scirrhus does not, but, on the other hand, becomes more salient in the gland. This has often proved useful in diagnosis. When, in spite of careful examination, the surgeon is in doubt, he should excise the portion of the breast containing the suspicious area and examine it under the microscope.

7. If, without redness of the skin or other sign of inflammation, gentle contact of the hand causes pain, there is **hyperæsthesia of the mamma.** If this tenderness involves the whole region, and if it is especially marked over the points of exit of the anterior and lateral cutaneous nerves of the second, third, fourth, and fifth intercostal spaces, and if the pain radiates to the back and shoulder, it may be diagnosed as **neuralgia.** But if the pain is elicited by contact with certain spots only of the breast, and, further, if at these spots small, firm, round or ovoid

tumours movable under the skin and over the breast in one direction are felt, and pressure upon them causes acute pain radiating over the mamma, the tumours may be recognized as **neuromata**, and as the source of the hyperæsthesia.

C. Cases of Tumour of the Breast

1. **The tumour is movable in the breast tissue.**—(*a*) If the tumour is movable in the breast tissue and is firm in consistence, it is a *fibro-adenoma*. A distinct ovoid and lobulated outline and slow rate of growth are other characteristic features of these tumours. They may be found in both breasts or multiple in one breast. The patients are usually young women. The one special distinguishing feature of this tumour is that it is not an infiltrating growth and is not fixed in the breast tissue. The firmer the tumour the greater the proportion of fibrous tissue in it.

(*b*) A tumour which, like the above, is movable in the breast tissue but is softer in consistence and finely lobulated is an *adenoma*. These tumours are rare; they resemble the healthy gland in structure and consistence; they may attain considerable size, displacing the breast to one side and forming the chief part of the prominence of the bosom.

2. **The tumour fluctuates.**—(*a*) If the swelling has arisen during pregnancy or lactation, is globular in outline, and uniform in consistence, without any sign of inflammation, it is a *galactocele*, or *milk-cyst*. These tumours are usually in the central part of the gland and painless.

(*b*) If the swelling has arisen independently of lactation, and without any evidence of inflammation, and there is no sign of infection of lymphatics or surrounding tissue, it is an *involution-cyst*. These cysts are frequently multiple, and vary much in size; they are most common in women from 30 to 50 years of age; when very small and numerous they give a shotty feeling to the breast.

(*c*) If a small lump which has been known to be present for many years takes on rapid growth, or if from its first appearance a swelling grows rapidly, at first as a single cyst, later becoming irregular in outline with cystic projections, is painless and unaccompanied by glandular enlargement, it is a *cyst-adenoma*, or *Brodie's tumour*. These tumours may attain a great size, and as the tumour enlarges, the skin over it may give way and a fungating, easily bleeding mass protrude. Such a growth is distinguished from a malignant tumour by the fact that the skin is not involved in the growth; a probe can be passed between the thinned skin and the intracystic portion of the growth.

(*d*) If the swelling has arisen during lactation or after a miscarriage, and has an ill-defined outline, and especially if there is œdema over it, or the part has been or is painful, it is a *chronic abscess*. This is most often found in the peripheral part of the gland.

(*e*) If the fluctuating swelling began as a small, painless, solid nodule, and has slowly become larger, fluid, and more superficial, and the patient is the subject of tuberculosis elsewhere, it is a *chronic tuberculous abscess*. In these cases the glands in the axilla may also be tuberculous.

In some cases an exact diagnosis can only be made if the swelling is punctured and its contents are drawn off and examined. The fluid may be pus, tuberculous débris, may contain a streptothrix (actinomyces), turbid brownish or greenish mucous fluid, milk, or the clear watery fluid of a hydatid cyst in which hooklets can be found.

3. The tumour is incorporated with the breast and is solid.—(*a*) If in a middle-aged or elderly patient there is on the nipple a chronic ulcer with firm, thickened, warty edge, and pink, irregular, indurated base, discharging ichorous fluid, and if the induration and the ulceration steadily increase in area, while the glands in the axilla are enlarged and hard, the disease is *epithelioma of the nipple.*

(*b*) If there is a firm, flat, disc-like lump in the areola, with a well-defined rounded edge, and the skin over it is fixed to this lump, and one or more enlarged and firm glands are felt in the axilla, it is a *carcinoma.* Later on the skin ulcerates.

(*c*) If the tumour is fixed in the breast tissue, is solid, but does not show any evidence of infection of lymphatics, it is a *sarcoma.* These tumours are usually globular in outline, grow rapidly, and form prominent masses. In some cases they grow slowly for a time. They may be so soft as to fluctuate, but if they are punctured, only blood is drawn off; or cysts may develop in the tumour containing discoloured serous fluid. Later on these tumours may fungate through an ulcer in the skin, but they do not involve the skin in their growth so rapidly or extensively as carcinoma does.

(*d*) If the tumour is fixed in the breast tissue, beneath or close to the areola, and is attended with a discharge from the nipple, it is either a simple distended duct, a duct papilloma, or a duct carcinoma. If the discharge is serous only, and by gentle pressure it is emptied and nothing can be felt of the swelling, it is a *dilated galactophorous duct.*

(*e*) If the tumour is very small and soft, but cannot be dispersed by gentle pressure, and the discharge from the nipple is sometimes serum and sometimes blood, and especially if these symptoms have existed for many months or years, it is a *duct papilloma.*

(*f*) But if the tumour is enlarging, or has reached the size of a pea, and is at all firm, and especially if an enlarged gland can be felt in the axilla, it is a *duct carcinoma.*

(*g*) If the tumour is fixed in the gland tissue, is solid, and has infected the lymphatic glands, or has caused dimpling of the skin over it, or retraction of the nipple, or tilting of the nipple towards the tumour, it is a *scirrhous* or *spheroidal-celled carcinoma.*

Scirrhous carcinoma.—As this is the variety of tumour of which the diagnosis is of most moment, the characters to be especially recognized may be further pointed out.

Clinical features.—The first and most important of these is the *infiltrating mode of growth.* Beginning in the gland, it is from the first absolutely fixed to it and immovable apart from it, and as it enlarges it infiltrates and becomes fixed in a similar manner to the skin over it and to the muscles beneath it; but these latter phenomena are observed only when the tumour has reached a certain size, and with very varying rapidity in different cases. Whenever this characteristic is well marked, scirrhus must be diagnosed unless absolutely contraindicated.

Contraction of the growth leads to dragging upon the galactophorous ducts and retraction of the nipple, and also to puckering-in of the skin over the tumour. The stage at which this feature can be recognized depends upon the situation of the growth: the more superficial it is, the earlier is dimpling of the skin observable; the more central the growth, the earlier is the nipple retracted. In some cases contraction is very marked; it is always a noteworthy symptom.

Glandular infection takes place early and very constantly. The affected glands, like the primary tumour, are firmer than normal, and usually progressively enlarge. There is great variation in the rapidity with which successive glands become infected, and also in the relative size of the primary and secondary growths. It is important to remember that when the original growth is near the inner margin of the breast, the glands of the opposite axilla may be involved quite early.

In addition to these signs, which may be called the cardinal signs of scirrhus, there are other phenomena of less constant occurrence but of diagnostic value when observed. Of these may be mentioned especially :

Paget's disease of the skin.—When a tumour is found in the breast associated with, and developed subsequently to, this form of chronic incurable eczema, it may with certainty be diagnosed as cancer.

Nodular growths in the skin.—The presence of firm nodules in the skin over and around the tumour in the breast is eminently characteristic.

Ulceration may be a striking feature, and the point to which attention should be directed is whether the skin is implicated in the growth before it breaks down, or whether, from pressure upon it, a portion of it sloughs or ulcerates and allows the subjacent tumour to fungate. This can be readily ascertained from the character of the edge of the ulcer.

Infiltration of the skin by growth before ulceration is characteristic of carcinoma. Fungation of a tumour through greatly thinned but non-infiltrated skin is sometimes seen in sarcoma or cystadenoma.

The facts in relation to age, heredity, pain, and cachexia are not of a nature to aid materially in the diagnosis in cases otherwise obscure.

Varieties of scirrhus.—Scirrhus occurs in the breast in several forms, and the following varieties at least can be clearly recognized:

1. The *tuberous*, where a distinct tumour is developed which grows steadily, and in which progressive new formation is the most characteristic feature.

2. The *ulcerative*, in which the growth quickly and widely ulcerates.

3. The *cicatricial*, characterized by slow development, and great contraction of the growth, which draws in towards itself all the surrounding parts, making a deep pucker in the breast or subcutaneous tissues.

4. The *atrophic* form, an exaggeration of the last. The growth of this is very slow, the tumour very small and very firm, ulceration is postponed for a long time even if it ever occurs, lymphatic infection is slow and mild, and the whole disease lasts for many years. The subjects of this form are usually of advanced years.

5. The *lymphatic* form, in which, with a small, slowly progressing primary growth, there is rapid and extensive infection of lymphatic glands, which is the chief source of the patient's sufferings.

6. Cancer "*en cuirasse*," in which the growth occurs widely in the skin in the form of scattered nodules, spreading and quickly running together into an unyielding cuirass-like casing of the chest.

7. The *acute* form, which has already been described (*see* p. 481).

In certain cases the nature of a tumour in the breast is seldom if ever determined before removal and apart from microscopical examination, e.g. very small tumours, and endothelioma, enchondroma, myxoma, gumma, hydatid and lymphatic cyst.

Diseases of the male breast.—Chronic mastitis, spheroidal-celled carcinoma, squamous epithelioma, cysts, and sarcoma occur in the male, and are to be recognized by the same features as in the female. Owing to the small size of the mamma in the male it is more difficult to distinguish between chronic mastitis and early carcinoma than in the female. Infiltration of the skin, a nodular outline of the lump, and enlargement of the lymphatic glands are the diagnostic signs of carcinoma.

CHAPTER XXXV

DIAGNOSIS OF DISEASES OF THE ABDOMINAL WALL

ONLY some of the diseases of the abdominal wa are peculiar to this region, or present special difficulties in diagnosis.

There is a small group of *congenital malformations* of the umbilicus, of which *hernia* (*see* Chap. XLI.) is the most common. A bright-red fleshy growth at the umbilicus, presenting a smooth surface, and a short central canal, and discharging mucus, is an *adenoma* or *polypus ;* but if it is lobular in outline, discharges pus, and has no central canal, it is a *granuloma.* Should the umbilicus be excoriated and a watery fluid escape from it, this is probably urine flowing through a *urachal fistula.* The detection of urea will determine that the fluid is urine. The urethra should then be examined for stricture. Congenital *fæcal, biliary*, or *gastric fistulæ* are sometimes met with.

When there is a direct communication between the skin and the intestine, so that the mucous membrane is continuous with the skin, the condition is spoken of as an *artificial anus.* The surgeon will know by the reaction and appearance of the discharge what part of the alimentary canal is opened. He should look carefully at the "spur" of the intestine, which projects into and sometimes blocks up the lumen of the tube, to ascertain whether there is a coil of intestine protruding behind it; this can be felt, or on manipulation a gurgle may be detected. A *fæcal fistula* may be met with in any part of the abdominal wall.

Biliary, pancreatic, and *gastric fistulæ* are recognized by the chemical and digestive characters of the fluid escaping from them.

A *sinus* may be met with as the result of an abscess in the abdominal wall, or in the abdominal cavity; the history of the case, the presence of other signs of disease, such as curvature of the spine or tumour in the abdomen, and the recognition of specific organisms in the discharge, will determine the diagnosis.

Tumours of the abdominal wall are to be distinguished from tumours of the abdominal cavity by their mobility with the belly-wall, and by the fact that they become more prominent when the abdominal muscles contract, as in coughing; abdominal tumours, if movable, move independently of the tissues over them. In some cases tumours beginning in the abdominal wall grow into the cavity and become adherent to the viscera, and intra-abdominal growths may extend into the belly-wall. The most common tumours are hernias, umbilical or ventral (Chap. XLI.), lipoma, fibroma, sarcoma, epithelioma, and abscess. **Lipoma** may be met with in the subcutaneous tissue, but the more important variety occurs in the form of small overgrowths of the fat of the subserous tissue projecting through apertures in the linea alba above the umbilicus. These are felt as small, lobulated, irreducible swellings, fixed on their deep aspect, movable under the skin. They may be tender, and are sometimes associated with vomiting and dyspepsia; they have been called "fatty hernias," but are to be distinguished from true hernia.

A **hæmatoma** in the sheath of the rectus muscle forms a tense and tender swelling of elongated form, dull on light percussion. It becomes more prominent when the patient coughs, and is by this fact distinguished, when on the right side, from an enlarged gall-bladder, or from an intra-abdominal swelling due to appendicitis.

An ill-defined, firm, slowly growing or stationary tumour of the deeper layers of the abdominal wall is a **fibroma or desmoid tumour**; this occurs most often in women who have borne children; it grows from and along the deep layer of the sheath of the rectus, and forms an elongated, irregular fibrous mass. This tumour may recur after apparently complete removal, and tends with the passage of time to become definitely sarcomatous in character.

An ovoid or globular mass, firm in consistence, attached to the broad muscles of the abdominal wall and steadily increasing in size, is a **sarcoma.** Sarcoma may arise in an irreducible omental umbilical hernia.

Epithelioma of the umbilicus occurs in two forms: (1) as a primary squamous epithelioma of the surface of the skin with enlargement of glands in axillæ and groins; and (2) as a columnar epithelioma of the subcutaneous tissue, secondary to a similar growth in the stomach or intestine, and situated in the subcutaneous tissue. In some cases such a secondary growth is the first indication of the presence of the disease in the digestive tract.

Abscess in the abdominal wall may be *superficial* or *deep*; the former is easily diagnosed by the fluctuation and the signs of acute inflammation. *Deep* abscess may form in the *sheath of the rectus* muscle or *underneath the muscular aponeuroses.* If a tumour with the signs of inflammation (pain, tenderness, heat, and redness) forms in the belly-wall, and its outline corresponds to one of the divisions of the rectus muscle, it is an abscess *in the sheath* of this muscle. Fluctuation is very difficult to obtain in acute abscess, and the induration and surrounding œdema are marked ; in chronic abscess, induration and œdema are absent and fluctuation is more distinct. These abscesses are to be distinguished from pointing intra-abdominal abscesses by the absence of an expansile impulse on coughing, and by the entire irreducibility of the swelling by pressure. Great care is required to distinguish the thrusting impulse of swellings in the abdominal wall from the increased tension and filling out of the tumour which characterize fluid swellings of the cavity extending into the walls. The *subaponeurotic* abscesses can only be distinguished from localized collections of pus in the peritoneal cavity by operation.

CHAPTER XXXVI

DIAGNOSIS OF ABDOMINAL SWELLINGS

The patient should lie flat on the back on a couch in a good light coming from above or from over the foot of the couch, and the whole abdomen should be exposed to view. The following methods of examination should be used.

Inspection quickly shows the size and general contour of the abdomen, and the freedom, uniformity or otherwise of abdominal respiratory movements. Irregularities of the surface should be carefully noted, and particularly any visible peristalsis, or such an outline as indicates the prominence of intestinal coils, stomach, uterus, or bladder.

Palpation.—Place the warm hand gently and quite flat on the abdomen, pass it carefully over the whole surface, and take note of the resistance felt, and of any variation in this resistance in different parts.

If any unusual or localized resistance is felt, notice particularly the position, size, and shape of this resistant part, its consistence, the presence or absence of fluctuation or of a fluctuation wave in it (*see* p. 221), and whether it can be moved by the hands.

Percussion.—First percuss lightly over the whole surface and notice any change in the normally resonant area or in the usual degree of resonance. Then percuss more deeply and notice again the same points. If any abnormal dullness is found, carefully note its extent, and whether it is constant or shifts under the influence of gravity as the patient moves first on to one side and then on to the other. If increased resonance is observed, it should be noted whether the accumulated gas which causes it is in the stomach, in the intestine —small or large—is free in the abdominal cavity, or is pent up in some limited space in an abscess cavity. By **auscultatory percussion** it may be possible to ascertain that the gas in a particular resonant area is or is not contained in the stomach or in the colon.

The **relation of the resonant and dull areas** must be fully investigated. If this can be varied by the position of the patient, it shows that liquid and gas are in one and the same cavity, the gas being either free or contained in the very mobile intestine. If the resonant area is above and the dull area below, it shows that there is some abnormal structure pushing up the intestines. If the dull area is above and the resonant area below, the pathological structure has grown from above and has pushed down the stomach and intestines, or possibly the intestines only. If there is dullness in the front of the abdomen and resonance in one or both flanks over the colon, the dull structure is quite certainly within the peritoneal cavity; while if the abdomen is resonant on light percussion and dull on deeper percussion, there is some dull substance behind the peritoneum.

Testing the mobility of the tumour.—There are three ways of testing the mobility of an abdominal tumour:

1. Grasp it in the hands and try to move it from side to side, from above down, and in some cases from before back. By this means not only the fact of its mobility or fixity is ascertained, but

also the direction and range of the mobility; and in some cases it is possible to make out that the mobility is like that of a pendulum, and that the tumour is really fixed at one end and swings, as it were, on that. For instance, a distended gall-bladder can be moved from side to side, but its fundus moves farther than its neck; and an ovarian tumour can be felt to be fixed below and yet move quite notably at its upper end. The direction of mobility is of value in such cases as "movable kidney," where the kidney moves freely vertically but hardly at all transversely.

2. Get the patient to breathe deeply and notice whether, and to what extent, the tumour is moved by the full descent of the diaphragm. It is the movable tumours which lie in immediate contact with the diaphragm that are especially moved by it, such as the liver—including the gall-bladder—the kidneys, the spleen, and the stomach.

3. In certain cases we can alter the position of a particular viscus, and then notice whether the tumour is moved at the same time or not. Thus, by distending the stomach we can move a still mobile tumour of the pylorus, or a tumour of the stomach-wall, or a mass of hair lying in its cavity.

By one or more of these methods the mobility of a tumour can be ascertained, and much learnt from the facts thus obtained. The student must remember the natural range of movement of nearly all of the abdominal viscera, especially the great omentum and the coils of the jejunum and ileum and their mesentery, and he must bear in mind that in certain conditions this mobility may be greatly increased, as in movable kidney and wandering spleen. It must always be remembered that a tumour of a naturally movable part may, by extension of its growth, by the formation of adhesions, or even by its mere size, become fixed.

Determining the outline of the tumour.—Pass the hand carefully over the tumour and note its general outline and any projections or depressions in it. (1) This will show whether the outline of the tumour resembles that of either of the solid viscera: e.g. the sharp lower edge of the liver, the notch in the anterior border of the spleen, the rounded lower pole and the hilum of the kidney, are quite characteristic. (2) A globular outline or globular projections are characteristic of fluid tumours; a nodular surface is often met with in solid growths, and especially in malignant growths. But in the abdomen we must remember that the nodular outline of benign tumours of the uterus, of fæcal tumours, and of the solid masses in tuberculous peritonitis is very characteristic. The dimpled surface of cancerous nodules in the liver is very characteristic when it can be felt.

Determining the consistence of the tumour.—As in other parts, it is very important to distinguish between solid and fluid tumours; in the abdomen we have in addition gas-containing "tumours" of the stomach and intestines, and gaseous abscesses. The methods of examining a tumour with this object are described at p. 221.

Effects of emptying or distending the hollow viscera.—The stomach can be emptied by a siphon tube, or distended with carbon-dioxide gas. The urinary bladder can be emptied by a catheter, or distended with gas or liquid. The rectum and colon may be emptied by purgatives or enemata, or distended with gas or liquid. The pelvis of the kidney may be emptied by a ureteral catheter. By these means much may be learnt. If the emptying of a hollow viscus dissipates the tumour, its nature is at once revealed; many a suspected abdominal tumour has disappeared when the bladder has been emptied! The effect on the position of the tumour, and on its accessibility, of emptying or distending a hollow viscus, is sometimes very notable. For instance, a stomach tumour may shrink up beneath the ribs or be displaced to or below the umbilicus a distended colon may almost conceal a tumour lying behind it.

X-rays are used in two ways in the diagnosis of abdominal tumours. Tumours are opaque to the rays, and their exact position and relation to the other abdominal organs can be studied on the fluorescent screen and in skiagrams. In this way an enlargement of the liver pushing upwards the diaphragm, or a subphrenic abscess, can be seen, and even the intimate structure as well as the attachment of an exostosis can be studied. It is also possible to pass into the alimentary canal, the bladder, and the pelvis of the kidney substances specially opaque to X-rays, and study thereby the relation of the tumour to the various parts of the alimentary canal and to the bladder and pelvis of the kidney. A meal containing barium can be traced as it passes from stomach to rectum, or a barium enema traced upwards. (*See also* Chap. XXXIX.) The bladder and the renal pelvis can similarly be filled with solution of collargol, or sodium bromide, and the relation of its black shadow to the less dense shadow of the tumour studied.

Pelvic examination.—A finger in the rectum or vagina can detect if any part of the tumour lies within the pelvis, and determine its relation to, or connexion with, one or other of the pelvic viscera, and to the pelvic wall. By means of a *sigmoidoscope* the inner surface of a growth of the rectum or lower segment of the pelvic colon can be seen. (*See also* Chap. XLII.)

Examination under anæsthesia is of great value, not only because it enables the surgeon to make his examination without causing any distress to his patient, but also because in deep anæsthesia complete muscular relaxation is obtained and the confusing effects of voluntary or reflex muscular contraction are eliminated.

Examination of other organs.—Notice in the male whether both testicles are in the scrotum, or whether either has never descended; or if one has been excised—if so, inquire for what reason. Any tumour of or about the testicle, either a malignant growth or a hydrocele, will be taken note of.

In the female an examination of the breasts may be important; if they show the mammary signs of pregnancy, or if a breast has been removed for malignant disease, it will have an important bearing upon the diagnosis of a tumour of the uterus, liver, or ovary. In both sexes alike the presence or history of removal of a melanotic tumour, or carcinoma of the rectum, or other primary source of a secondary abdominal growth, is important. The evidence of tuberculous disease, of syphilis, of chronic suppuration, of renal or cardiac disease, or of disease of the lungs or pleura may have a distinct bearing upon the diagnosis of an abdominal tumour.

Examination of the blood.—The evidence of primary or of secondary anæmia, of leucocytosis in one or other of its various forms, and of eosinophilia may be of great assistance.

Having completed the examination, the surgeon has to determine three points: (1) whether a tumour is actually present; and if so, (2) the seat of the tumour, and (3) the nature of the tumour. We will discuss the subject under those heads.

I. PRESENCE OF A TUMOUR

There are five conditions that may possibly be mistaken for actual abdominal tumour:

1. Obesity.
2. The contracted rectus abdominis.
3. Irregular contraction of abdominal muscles.
4. Flatulent distension of stomach or intestines.
5. Tumour of the abdominal wall.

1. The fact of **obesity** cannot, of course, be overlooked, but a great accumulation of fat in the abdominal wall and the omentum may easily be mistaken for an abdominal tumour, especially when the abdomen is pendulous. To avoid this error it will be sufficient to notice—(*a*) the uniformity of the thick abdominal wall and the absence of definite outline to the supposed tumour; (*b*) that when the abdominal wall is grasped and moved from side to side no sense of a tumour deep to it is given; and (*c*) the resonance on deep percussion over the supposed tumour. The "tumour" is generally thought to be in the lower part of the abdomen, and a pelvic examination, when it reveals the absence of any abnormal swelling in the pelvis, is further evidence that there is no tumour. In examining a fat abdomen the hands must be pressed in correspondingly deeply. It is well to bear in mind that while obesity may be mistaken for a tumour, it often conceals and renders difficult of recognition small tumours, e.g. growths in the colon, ovarian cysts, uterine fibromata, slight enlargement of the liver: it is only by special care and thoroughness in the examination and by a recognition of the particular difficulties that error will be avoided.

2. The resistance offered by a **contracted rectus** muscle—especially a contraction of one of the divisions of this muscle—may closely resemble a tumour. It will, however, be noticed that the outline of the supposed tumour corresponds to that of the muscle, and that the part is not dull on percussion; and very probably, when the shoulders are raised and the thighs flexed, and the patient's attention is diverted from the examination, the muscular rigidity may lessen or pass away altogether. Under an anæsthetic the muscular contraction will certainly pass off and the absence of tumour be established.

3. There are cases where from **irregular and unusual muscular contraction** some part—usually the lower mesial part—of the abdomen is made quite prominent with a fairly well defined outline; the "tumour" persists for weeks together, possibly even for years. When examined, there may be some alteration in the percussion note over the swelling, but it is not absolutely dull, nor can it be moved beneath the abdominal wall; it is usually entirely free from tenderness, its surface is always even. No part of the "tumour" can be felt in the pelvis. When an anæsthetic is given to the degree of complete muscular relaxation, the appearance of tumour entirely passes away. This is the condition usually spoken of as *phantom tumour*. It is generally met with in women who show also signs of hysteria.

4. **Flatulent distension** of the stomach or intestine is readily recognized by the tympanitic percussion note over the part, and usually also by the belching-up of wind or the passage of flatus. In general meteorism, peristalsis is arrested and no flatus is passed.

In the great majority of cases it is quite easy to be sure of the presence of an abdominal tumour, and, where doubt exists, an examination under an anæsthetic will determine the point.

5. **Tumours of the abdominal wall** are distinguished by their special mobility, and by their becoming more prominent when the patient coughs or puts the abdominal muscles into action. (*See* p. 492.)

II. SEAT OF THE TUMOUR

To know what organ or part is the seat of the tumour, attention must be paid to its *exact situation in the abdominal cavity*, to its *relations to the resonant stomach and intestines*, to its *mobility*, and to its *outline*, for some organs even when enlarged retain a characteristic outline. In some cases the nature of a tumour throws light upon its seat, and in other cases special symptoms are connected only with tumours of particular organs. Sometimes such symptoms as pain, vomiting, jaundice, hæmaturia, aid the diagnosis.

1. A tumour projecting from under the right false ribs and at the epigastrium, which is dull on percussion, with a distinct lower edge passing more or less transversely across the belly, and which is depressed by a deep inspiration, is a **liver tumour.** The dullness is continuous with the normal liver dullness above, and entirely above the resonance of the stomach and colon.

2. A tumour felt in the right loin projecting from beneath the ribs, with a distinct thin lower edge, descending with inspiration, but with the fullest inspiration having no upper edge or limit, and not being entirely "reducible" beneath the ribs by gentle upward pressure, is a **Riedel's lobe of the liver.** This is most likely to be mistaken for a movable kidney, or an enlarged gall-bladder; both occur much more often in women than in men. It is

especially distinguished from a kidney by the sharper lower edge as contrasted with the rounder edge of the kidney, by the inability to feel any upper edge —it is merely a tongue-like prolongation of the liver —and by its not slipping up under the ribs when gently pressed up. There is also an absence of the symptoms often attending a movable kidney, but this does not afford much aid in diagnosis, as even considerable mobility of the kidney may be present without subjective symptoms. The sharp lower edge, if it can be felt, also distinguishes it from an enlarged gall-bladder, but the presence of symptoms of disease of the gall-bladder—of which Riedel's lobe is usually an unimportant sequela—adds to the liability of this mistake being made.

3. A tumour beneath the upper part of the right rectus abdominis muscle, having a rounded lower end with a smooth rounded surface, but having no upper margin—the upper part of the tumour disappearing beneath the lower edge of the liver—which is felt to descend when the patient takes a deep inspiration, is a **gall-bladder tumour.** This tumour is dull on percussion, the dullness being continuous with that of the liver: the resonant colon is below it, and may overlap its lower edge; the tumour, if large, has some lateral mobility when the abdominal walls are relaxed. The fact that the tumour is inseparable from the liver is of primary diagnostic importance. There may be pain or jaundice, or a history of either or both, to support the diagnosis. If an enlarged gall-bladder becomes adherent to the abdominal wall it loses its downward mobility with inspiration.

4. A tumour in the right loin, of firm consistence, with a rounded contour, which descends with deep inspiration so that the fingers can then be passed

between its upper edge and the ribs, and ascends with expiration, and by gentle pressure from below can be made to disappear altogether beneath the false ribs, is a **movable kidney.** The degree of mobility varies: it is chiefly, if not wholly, vertical, and the kidney may be found in the iliac fossa, or even as low as the brim of the pelvis. In some cases the concave hilum of the kidney can be identified. There is often a lesser degree of mobility of the left kidney, and very rarely the left kidney only is movable, or is the more movable of the two. When the kidney can be moved not only vertically, but freely in a transverse direction also, transgressing the middle line, it is a **floating kidney.**

5. A tumour in the loin projecting from beneath the last rib and filling out the space between it and the iliac fossa, which on bimanual examination is felt to project behind, or by gentle pressure on the front is made to project behind, which moves very little if at all on deep inspiration, which is dull on percussion, with intestinal (colon) resonance in front of it, is a **renal tumour.** As it enlarges, the tumour may encroach upon the iliac fossa, and may extend towards and even beyond the middle line, pushing the resonant colon farther and farther from the side. Changes in the urine, hæmaturia, pyuria, or the subsidence of the tumour at the same time as a large quantity of urine is passed, may aid the diagnosis.

6. A tumour projecting below and in front of the left false ribs, with a vertical and notched anterior edge and smooth outer surface, which descends on deep inspiration, is a **splenic tumour.** Changes in the blood may strongly support the diagnosis. In some cases it is difficult to distinguish an enlarged spleen from an enlarged left kidney. A splenic tumour does

not fill out the loin so markedly as a renal tumour does; by percussion it can be traced higher up on the left of the stomach, whereas the kidney is altogether behind and below the stomach, and the resonance of the stomach can be made out above it. There may be colon resonance behind the lower part of the spleen; this is never the case in a renal tumour. By attention to these points it is possible to distinguish with certainty between these two tumours even when no changes in the blood, nor history of ague, nor renal symptoms, nor urinary changes are present.

7. A smooth, rounded, tense tumour, projecting above the symphysis pubis exactly in the middle line with a rounded dome-like outline, dull with resonance above and on each side, not moving at all freely from side to side, which is felt bulging into the pelvis in front of the uterus or beyond the prostate, and which disappears when a catheter is passed and a large quantity of urine is evacuated, is a **bladder tumour.** Such a tumour may easily be mistaken for a uterine or ovarian tumour until a vaginal examination is made or a catheter passed. With one finger in the vagina or rectum, and the other hand over the hypogastrium, fluctuation can easily be detected. In certain uncommon cases a bladder tumour does not disappear on passing a catheter. It may be distended with a blood-clot; then, when a catheter is passed, no urine flows, and its eye is found to be occluded with clot. In other cases, again, a malignant tumour of the bladder may project or be felt above the pubes. In both conditions the patient's symptoms prevent error in recognizing the seat of the tumour.

8. A tumour occupying the lower part of the abdomen inseparable from the pelvic brim below,

with intestinal resonance above it and on each side in the flanks, is a tumour originating in the pelvis, and growing up into the abdomen. In the male, if it is not a bladder tumour, it will be a growth springing from the pelvic wall. In the female also it may be that, but more often it is a tumour of the uterus, or of one of the uterine appendages.

An exactly median position is in favour of a uterine tumour, but small uterine tumours may be placed laterally: an ovarian tumour at first is always laterally placed, but, when large, becomes central, so that too much weight must not be attached to this point. By a careful bimanual examination it is usually possible to determine the continuity of the tumour with the uterus, or the contrary, either by the outline of the mass, or by the associated movement of the two. In tumours arising from the structures in the broad ligament the uterus may be displaced to the opposite side, depressed or raised, and the fundus uteri may be clearly felt distinct from the main mass of the tumour. The nature of the tumour in many cases goes far towards establishing the diagnosis; evidence of pregnancy, or the firm solid consistence of the tumour, are strong points in favour of a **uterine tumour**; if the tumour consists of one great cyst, or of a multilocular cyst, that fact is equally strong in favour of a **broad-ligament tumour,** usually of an **ovarian tumour.** An ovarian tumour may have a long pedicle, and thus be very movable within the abdomen, passing across from side to side, and well up out of the pelvis. It has then to be distinguished from an equally movable cyst in the great omentum. This can be done by noticing that the mobility of an ovarian tumour is always limited in the upward direction—when pressed upwards as far as it will go, the tense pedicle can often be felt below it—and that the mobility of the omental tumour is always limited downwards, while it can be moved upwards without restraint. An ovarian tumour thus movable is very liable to suffer from **torsion of its pedicle,** causing sudden pain, vomiting, and increased size and tension of the cyst, with tenderness and perhaps severe or even fatal peritonitis. (*See* p. 542.) When less severe this accident leads to adhesions about the cyst, which fix it, and if it becomes fixed at a distance from the pelvic brim it may be impossible to diagnose its nature with certainty. A subperitoneal fibroid may also have a long pedicle admitting of unusually free movement, and such a tumour may become fixed by inflammatory adhesions and be difficult to diagnose, but the very firm consistence of the tumour, its globular outline, and the presence of other uterine fibroids, or a certain degree of displacement of the uterus towards the tumour, and limitation of the normal mobility of the womb, will generally reveal the nature of the case.

If the pelvic tumour is fixed to the bony walls, and the uterus and appendages are displaced by it and are not adherent to it, it will be evident that it is a **tumour of the pelvic wall,** and not of any of the viscera. Such tumours, if malignant, may later on become attached to the viscera.

9. A tumour between the umbilicus and the xiphoid cartilage may be connected with the liver, the stomach, the colon, the small omentum, or the pancreas, or be a retroperitoneal tumour other than of the pancreas. If it is continuous with the liver above both to touch and by percussion, and moves freely with the diaphragm, and has a distinct transverse thin lower edge, it will easily be recognized as a **liver tumour.** (*See* p. 503.) If, however, it is clearly marked off

from the liver above, and moves with respiration and also from side to side, it is certainly neither hepatic nor retroperitoneal, and if there are gastric symptoms—pain, vomiting, hæmatemesis, distension of the stomach—it is certainly a **pyloric tumour.** A skiagram of an opaque meal will afford great assistance in such a case. The tumour is most often carcinomatous, and as it grows it extends to the left along the stomach, and also may become fixed to the liver, pancreas, colon, or the abdominal wall. It then loses its mobility, but the development of gastric disturbance renders the diagnosis plain. A pyloric tumour may have a great range of movement laterally; we have known it capable of passing quite under the left ribs and well beyond the middle line to the right.

If the tumour is clearly marked off from the liver above, moves very little with the descent of the diaphragm, but more freely laterally, has stomach resonance above it, and colon resonance to the right of it but not plainly to the left of it, it is most probably a **tumour of the transverse colon.** The absence of stomach symptoms, with distension of the cæcum and the colon to the right of the tumour, but the absence of such distension to its left side are the special features to notice. A history of an alteration in the normal action of the bowels, either in the shape of diarrhœa or of increasing constipation, distinctly favours the diagnosis. Confirmatory X-ray evidence is afforded by failure of a barium mixture, given as an enema, to pass up the colon beyond the tumour, or by a well-marked filling defect at this point.

If the tumour is fixed posteriorly, moving neither with respiration nor laterally, and there are jaundice, rapid emaciation, and fatty stools, it is a **tumour of the**

head of the pancreas. If there is jaundice from this cause the gall-bladder will certainly be distended with bile. If the tumour is small, on light percussion there will be stomach resonance over it. A tumour of the tail of the pancreas projects to the left of the middle line just in front of the left false ribs, has stomach or colon resonance in front of it, and is fixed to the spine. It is only distinguishable from other retroperitoneal tumours in this situation if it is recognized as a cyst.

If the tumour is separable from the liver, can be shown to move independently of the liver, especially transversely, or if the lower edge of the liver can be felt distinct from the tumour, and with this the stomach is found by percussion and X-rays to be displaced below the tumour, it is a **tumour of the lesser omentum.** These tumours are excessively rare; they may attain an enormous size; but, however large they may be, the stomach is invariably displaced below the tumour.

10. A tumour bulging the epigastric region, and extending downwards from beneath the left false ribs—possibly even as far as the pelvis—tympanitic on percussion, yielding the "bell-sound," and attended with a succussion splash, is a **dilated stomach.** The emptying of the organ by a siphon, or by occasional very copious vomiting, will establish the diagnosis.

11. A tumour below the umbilical level, freely movable from side to side and upwards, but not capable of free downward displacement, with stomach and colon resonance above it, colon resonance on each side of it, and—if it does not reach the pelvis—an intestinal note below it, is a **tumour of the great omentum.** When very large its range of lateral mobility is correspondingly limited.

12. A tumour below the level of the navel, with a considerable range of movement both vertically and from side to side, and which does not give the sensation of being attached either above or below, is a **mesenteric tumour.** If small, it lies behind coils of intestine which give a resonant percussion note; but if large, it may press these aside and give a dull note.

13. A tumour having the form of a transverse fold or ridge below the transverse colon, with very little, if any, movement, is a characteristic effect of **tuberculous peritonitis.** Other more or less well-defined masses of tuberculous glands may be felt at the same time. The history of the case may clearly establish this diagnosis.

14. A tumour in either iliac fossa or loin may be a tumour of the corresponding part of the colon. If it is movable over the posterior abdominal wall, does not bulge into the loin, and is not quite dull on percussion, it is a **tumour of the colon.** The sigmoid flexure has a greater range of movement than the rest of the colon. The tumour may be elongated in shape, and extend some distance along the colon. There may be symptoms to support the diagnosis, such as pain, constipation, irregular motions, the passage of mucus and blood, or absolute constipation. When the colon is acutely or greatly distended its cylindrical outline may be apparent; it is then tympanitic on percussion, and sometimes periodically hardens under examination, or loud gurgling sounds are heard in it. Skiagrams of an opaque meal or enema afford great assistance in the diagnosis.

15. A tumour of the abdomen which has no defined outline, and is dull on percussion, the dullness shifting with the position of the patient—in dorsal

recumbency the flanks and hypogastrium being dull and the umbilical and epigastric regions resonant, while with the patient lying on one side the other side becomes resonant and the level of dullness rises in the dependent flank—is caused by **intraperitoneal fluid.** Occasionally, when examining an abdomen, on gently but quickly depressing the fingers a firm tumour is felt through a thin layer of free peritoneal fluid. It may be a large single tumour such as an ovarian cyst, or a cancerous liver, or several smaller nodules may be felt, as in diffused peritoneal cancer or tuberculous peritonitis. Still more rarely, in a distended abdomen there is found an irregular distribution of dullness and resonance, caused by a combination of peritoneal effusion and adhesions leading to an *encysted ascites* or a *loculated ascites.* If there is a single dull area in the centre of the abdomen with resonance above and below and on each side of it, this may be *effusion into the lesser peritoneal sac* (*bursa omentalis*).

16. If a tumour in any part of the abdomen is absolutely fixed on its deep aspect, and evidently displaces the viscera in front of it, as shown by resonance over it, and the mobility of the intestines and omentum over the tumour, it is a **retroperitoneal tumour.**

17. If the tumour is fixed deeply, has developed rapidly, and the viscera are not displaced by it or freely movable over it, it is either an **intraperitoneal abscess** or a rapidly growing **malignant tumour** of the alimentary canal.

18. If the patient has an undescended testicle, and on the same side a tumour is found just above the inner part of Poupart's ligament, or—very rarely—close to the kidney, it is most probably a **tumour of an undescended testicle.**

III. Nature of the Tumour

It is not necessary to discuss here all the points upon which the diagnosis of the nature of the tumour depends, as much that has been said in Chap. XVII. on the general question of the diagnosis of tumours applies as fully to tumours within the abdomen as to tumours elsewhere. The symptoms which lead to the distinction between solid and fluid tumours, between cysts and abscesses, between inflammatory and neoplastic swellings, and between benign and malignant growths, are in the main the same, whatever the seat of the tumour. The reader is assumed to have made himself acquainted with the contents of Chap. XVII.; and space forbids our entering upon many details which are primarily the study of physicians and gynæcologists. Following the order observed in the previous section, we shall try to state the main facts about the tumours of the various organs and parts upon which a diagnosis of their nature may be founded.

1. **Tumours of the liver.**—If the liver is uniformly enlarged, smooth on the surface, firm, with a well-defined edge, moving freely with the descent of the diaphragm, and the patient is the subject of chronic suppuration, it is an *albuminoid liver*. Moderate enlargement of the spleen, a hectic temperature, night sweats, wasting, and diarrhœa would confirm this diagnosis.

If the liver is uniformly enlarged, firmer than normal, with a well-marked, firm edge, slightly tender to the touch, with perhaps some friction to be felt or heard over it, and the patient is the subject of chronic alcoholic excess, it is *hypertrophic cirrhosis*.

If the liver is rapidly enlarging and forms a very solid tumour with a firm, rounded edge, and the patient is very ill, rapidly wasting, with anorexia, vomiting, perhaps jaundice, it is *carcinoma of the liver*. This is usually secondary to cancer of the alimentary canal or breast, and often discrete nodules of the growth can be felt on the surface, and in thin subjects the depressed umbilicated centre of such a nodule may be recognized. Primary carcinoma is, however, not so rare as was supposed. The urine is heavily loaded with urates in carcinoma of the liver. Secondary *sarcoma of the liver* is indistinguishable in its physical characters from carcinoma, than which it is much less frequent; it is recognized when the nature of the primary tumour, e.g. melanotic sarcoma, is known.

If the liver tumour has grown slowly and has assumed a more or less globular shape, with a smooth, uniformly tense outline, and especially if fluctuation can be obtained through the tumour, or hydatid fremitus, or when the patient has lived for long in a locality where hydatid disease is common, such as Australia or Iceland, it may be recognized as *hydatid tumour of the liver*. The tumour varies in size from a marble to one of enormous proportions; its contour largely depends upon its exact seat in the liver—if on the surface it forms a globular projection from the organ; if deep in the substance of the gland the whole liver becomes enlarged. There is no fever, and the patient's general health is not seriously disturbed. An examination of the blood may show an excess of eosinophile cells. When a patient in this condition is seized with pain in the part and his temperature rises and he becomes very ill, *suppuration of the cyst* has occurred.

If the liver is enlarged and the patient is suffering from fever with sweats, wasting, and complete anorexia, and there is pain in the right shoulder, and a heavy dull pain referred to the liver, and especially if the patient has suffered from amœbic dysentery, or the specific amœba can be found in the stools, the diagnosis of *abscess of the liver* must be made. The enlargement of the organ may be chiefly upwards, bulging up the diaphragm; the abscess may be so large as to give a sense of fluctuation, or it may be actually pointing. In many cases it is only when pus is evacuated that the diagnosis is assured. Leucocytosis is not constant in liver abscess.

When the liver is moderately enlarged, tender to the touch, perhaps tender at certain spots only, and the patient has a pyæmic temperature with rigors and profuse sweats, and wastes rapidly, it is a case of *suppurative pylephlebitis*. In these cases there is some source of infection in the area draining into the portal vein, e.g. appendicitis, or ulceration of stomach or intestine or gall-bladder; the knowledge that such a lesion exists, of course, aids in the diagnosis.

An irregular, bossy enlargement of the liver occurring in a child who bears evident marks of congenital syphilis, or in an adult who is suffering from tertiary syphilis, is a *gumma*. A positive Wassermann reaction confirms this diagnosis.

2. **Tumours of the gall-bladder.**—If an enlarged gall-bladder is firm, or even hard to the touch, only slightly tender, and the patient has long suffered from dyspepsia with more or less local discomfort, the case is one of *gall-stones*. The gall-stones may be visible in a skiagram. But if with such a history the gall-bladder is found tense and rounded, and there is acute tenderness on deep pressure at the epigastrium, but no jaundice, it is a case of a *gall-stone impacted in the cystic duct* with mucous distension

of the gall-bladder. In most cases there is pain, often severe pain, but this may gradually subside without removal of the obstruction; there may be slight jaundice, from projection of the impacted stone into, or a second stone lying in, the common bile-duct. A history of attacks of biliary colic in the past, of course, aids the diagnosis. When a gall-stone is *impacted in the common bile-duct* it causes complete jaundice, but the gall-bladder is not distended unless there is simultaneous impaction of a stone in the cystic duct. But *pressure upon the common bile-duct* from without causes complete jaundice with distension of the gall-bladder. Such pressure is most often due to enlargement of the head of the pancreas, to cancer of the pylorus, or to adhesions round the duct, very rarely to a large calculus in the pancreatic duct. Persistent complete jaundice, which has come on abruptly, without enlargement of the gall-bladder, and is associated with tenderness at the epigastrium, irregular fever, and rigors, is evidence of *impaction of a stone in the common duct*; persistent jaundice with distension of the gall-bladder is evidence of *compression of the common bile-duct.*

If a distended gall-bladder is found to be exquisitely tender and the seat of severe throbbing pain, and the patient's temperature is high, acute inflammation, *cholecystitis*, and probably *suppuration* or even *gangrene of the gall-bladder* have occurred. Friction may be heard over the gall-bladder early in the attack; later on the viscus becomes adherent and does not move with respiration.

A progressive nodular, solid enlargement of the gall-bladder, with gradual loss of its mobility and development of cachexia, points to *cancer of the gall-bladder.* The growth extends directly into the liver, and also causes secondary deposits in that organ.

3. **Renal tumours.**—For the diagnosis of these tumours, *see* p. 702.

4. **Splenic tumours.**—A splenic tumour that can be entirely replaced beneath the left ribs, and that then, by deep inspiration, or by standing up or turning on to the right side, falls downwards and forwards from beneath the ribs, is a *wandering spleen.* An enlarged spleen in a patient who has suffered from malaria will readily be recognized as a malarial or *ague spleen ;* the occurrence of the typical febrile attacks, and during one of them the detection of the plasmodium in the blood, will confirm the diagnosis. A steadily enlarging spleen, with progressive anæmia and great increase in the polymorphonuclear cells of the blood, is due to *spleno-medullary leucocythæmia.* But if the enlarged spleen is unconnected with ague or with torsion of its pedicle, and there is no leucocytosis, but progressive anæmia with diminution in the number of the red blood-cells and in the percentage of hæmoglobin, it is a case of *splenic anæmia.* If a splenic tumour with these characters is associated with enlargement of the liver and ascites, the condition is known as *Banti's disease.* There are also cases of chronic enlargement of the spleen, in children and young people, which are associated with periodic attacks of jaundice without the presence of bile in the urine—*acholuric jaundice* of childhood ; the disease, which often attacks several members of a family, is curable by splenectomy. A chronic globular, tense, fluctuating tumour of the spleen is a *hydatid tumour. Malignant tumour* and *abscess* are occasionally met with in the spleen.

5. **Uterine tumours.**—In every case of uterine tumour the question of *pregnancy* is to be first considered, and it must be remembered that the obvious

existence of other uterine disease, such as fibroid tumour or cancer of the cervix, does not exclude pregnancy. A solid tumour of the uterus, of slow growth, perhaps remaining stationary in size for years, or diminishing at the menopause, either uniform in shape or coarsely lobed, either causing no symptoms except from its size, or attended with menorrhagia, or metrorrhagia, or leucorrhœa, is a *uterine fibroid.* A globular mass of the tumour projecting from the surface, or movable over it, will be easily recognized as a *subperitoneal fibroid* tumour. A uterine tumour appearing at middle life or later, growing steadily but not attaining to a great size, and attended with pain, a sero-sanguineous vaginal discharge, and increasing cachexia, is *carcinoma of the fundus uteri.* An examination of the interior of the womb and of a portion of the growth removed by a curette is usually necessary to establish the diagnosis before the late stage of the disease. A rapidly growing tumour of the uterus with uneven surface, diminishing mobility, and later on cachexia and ascites, is probably a *sarcoma of the uterus.*

6. **Broad-ligament tumours.**—A tumour springing from the broad ligament, which has a smooth even surface and fluctuates throughout, particularly if it has slowly and painlessly developed and has but little mobility, is a *parovarian or broad-ligament cyst.* But if the tumour has an uneven surface, fluctuates in one or more places, and consists of more than one cyst, or of cyst and solid matter combined, it is an *ovarian cyst.* If the tumour is freely movable, evidently having a distinct or even a long pedicle, this shows that it is ovarian rather than parovarian. Mobility of the tumour, and evidence of something in addition to a single thin-walled cyst, are the symptoms by which an abdominal ovarian tumour

is differentiated from a broad-ligament cyst. A rapidly growing solid tumour with nodular uneven surface, becoming more and more fixed, and associated with ascites, vomiting, wasting, and cachexia, is a *malignant tumour of the ovary*. This may be a primary or a secondary growth.

A very slowly growing, firm, solid tumour of the ovary, or one that is known to have remained stationary for some time, may be a *fibroma*. A slowly growing, soft, solid, coarsely lobulated tumour of the broad ligament, unassociated with symptoms other than those due to its bulk, is a *lipoma of the broad ligament*. When after tapping an ascites an irregular firm tumour is found in one or both broad ligaments, it is a *papillary cyst of one or both ovaries*. Rapid re-collection of the ascitic fluid will certainly occur; the fluid may be blood-stained. The general health suffers but little, if at all, and these cases, if not recognized and properly treated, may go on for years with repeated tappings and the removal of very large quantities of fluid. A solid or partly solid tumour, with very limited mobility, occurring in a girl or young woman, is most probably a *dermoid ovarian tumour*. These tumours are liable to suppurate, and if the abscess is opened or bursts the escape of sebaceous matter, hair, or teeth reveals at once the nature of the original tumour. A dermoid tumour, although congenital, may not give rise to any symptoms or grow to any size until adult life.

7. **Tumours of the pylorus.**—A tumour of the pylorus, of small size, which is observed to remain stationary in size and smooth in outline, is a *fibrous stricture of the pylorus*. Chronic dilatation of the stomach, and a history of pain some time after taking food, perhaps of vomiting and hæmatemesis—symp-

toms pointing to ulcer at or near the pylorus—would confirm the diagnosis. But if the tumour is known to have appeared quite recently and is noticed to enlarge, if it has an uneven or nodular contour and its mobility is lessening, and if it is associated with recently developed and progressive dyspepsia, vomiting, delay in emptying and altered gastric secretion, revealed by a test-meal, wasting and anæmia, it is *carcinoma of the pylorus.* (*See* p. 576.)

A small, firm, barrel-shaped tumour, not exceeding in size a hazel-nut, felt in the region of the pylorus in an infant, usually a male, a few weeks old, and accompanied by visible peristaltic waves in the stomach, loss of weight, forcible if not frequent vomiting, and constipation, is *congenital hypertrophy of the pylorus.*

8. **Tumours of the pancreas.**—A solid fixed tumour in the head of the pancreas, with persistent jaundice, enlarged gall-bladder, rapid emaciation and cachexia, is a *carcinoma of or involving the pancreas.* There may be vomiting, fatty stools, glycosuria, and a great increase in the diastase in the urine. A tense globular tumour of the pancreas is probably a *pancreatic cyst,* and if it attains a considerable size and fluctuation can be detected in it, or if there is a history of injury preceding its development, the diagnosis is assured. A chronic moderate enlargement of the whole pancreas, with pain in the back and local tenderness, is probably caused by *pancreatic calculi* ; this may lead to persistent jaundice, with a distended gall-bladder. (*See* p. 573.) Pancreatic calculi are demonstrable by X-rays.

9. **Tumours of the omenta.**—A tense globular movable tumour of the omentum is probably an *hydatid cyst* ; if there is eosinophilia and if fluctuation can be obtained the diagnosis is certain. A very chronic solid tumour with an uneven or lobed surface, and

not attended with ascites and cachexia, is a *lipoma of the omentum.* But a rapidly growing solid tumour, firm, nodular, attended with ascites and cachexia, is a *malignant tumour of the omentum. Myxoma* may be met with in the omentum, but is only distinguished from a lipoma after its removal.

10. **Mesenteric tumours.**—A globular tense tumour is a cyst. If small, chronic, and symptomless it is almost certainly a *lymphatic cyst*, or a *chylous cyst.* If larger and firmer it is most probably a thick-walled cyst containing putty-like material, the nature of which is not definitely ascertained. Some believe these cysts to be tuberculous, others think they are congenital in origin and allied to dermoids. They may be painful at times and a little tender. A soft, solid, irregularly lobed tumour of very slow growth is a *lipoma.*

11. **Tumours of the intestine.**—The first thing to determine in regard to any tumour of the intestine is whether it is *fæcal* in nature. The signs by which a fæcal accumulation can usually be recognized are a firm consistence, a nodular outline, no diminution in the mobility of the bowel, the possibility of indenting the mass by firm pressure with the fingers, and above all its movement along the course of the colon and its ultimate disappearance after repeated free evacuations of the bowel. The tumour is not dull on percussion, owing to the admixture of flatus with the fæces. The history may be misleading, as there may even be irritative diarrhœa associated with fæcal accumulation. The most common seats of fæcal tumours are in the cæcum and at the hepatic, splenic, and sigmoid flexures of the colon. A fæcal tumour may be the result of the obstruction of the bowel by a malignant stricture, and this possibility must always be remembered. A firm nodular

tumour of the intestine with signs of ulceration of the mucous surface and of obstruction to the easy passage of fæces along the colon—mucous and bloody diarrhœa, griping pains, small broken-up motions, distension of the bowel on the proximal side of the tumour—is a *carcinoma of the colon.* As the disease advances the tumour becomes fixed, and secondary growths may be found in the liver, the abdominal wall, etc. Sudden complete obstruction may be the first symptom noticed by the patient. Fæcal vomiting without other signs of intestinal obstruction indicates ulceration between the colon and the stomach.

A firm tumour of the sigmoid flexure in a fat person, associated with chronic constipation and the passage of small scybala like sheep-droppings, or more definite signs of chronic intestinal obstruction, may be due to *chronic diverticulitis.*

A small smooth or lobulated tumour in the intestine, not increasing in size, not lessening the normal mobility of the bowel, and associated with a certain amount of griping pain, is probably a *lipoma, polypus, or myoma of the bowel.* The exact nature of the tumour can only be determined by an operation. An elongated tumour of the colon which becomes firmer and clearer in outline when handled, and then after a few minutes softer and less distinct, associated with griping pains, tenesmus, and the passage of mucus or blood with small broken-up motions, is a *chronic intussusception.* In very rare cases the right iliac fossa and right loin are unusually empty, and the end of the intussusceptum can be felt in the rectum.

12. **Retroperitoneal tumours.**—The special features to determine in these cases are the mobility of the tumour, its rate of growth, its outline, the presence

in it of fluctuation or pulsation, and signs of disease of the spine.

If the tumour is absolutely fixed to the spine or ilium, grows steadily or rapidly, is solid, and is uneven on the surface, it is a *malignant tumour*. This may be a primary sarcoma of the bone, most often seen in the ilium, or a secondary carcinoma, most often met with in the lumbar glands in connexion with carcinoma of the testicle. A very firm chronic tumour absolutely fixed to the bone, with a lobulated surface, is an *exostosis*; it may be felt to have a stalk-like attachment to the bone; a skiagram will show its outline and nature quite clearly. A very chronic tumour, soft in consistence, uneven in outline, and with a slight degree of mobility over the spine, is a *lipoma*.

A chronic retroperitoneal swelling with well-defined outline, tense, smooth, and fluctuating, is a *tuberculous abscess*; the position and shape of the swelling will determine whether it is a *psoas* or an *iliac abscess*. (*See also* p. 667.)

A pulsating swelling may be an *aneurysm*. Such a case must be examined with great care (*see* Chap. XX.). If the pulsation can be felt along a line passing from epigastrium to navel and, when the patient kneels up and completely relaxes the abdominal muscles, pulsation is not felt by a hand laid lightly on the part, the case is one of *pulsating aorta*. The pulsation is felt solely on account of thinness and loss of tone of the abdominal wall, and the condition is most often met with in women. A very vascular sarcoma may pulsate. An *aneurysm* will be diagnosed only when a tumour which presents an expansile pulsation and a bruit can be identified; the bruit may be chiefly audible posteriorly; there may be severe pain from pressure upon the spinal nerves, or jaundice from pressure upon the bile-ducts, or hæmorrhage from stomach or intestine, or sudden profuse hæmorrhage into the peritoneal cavity, from rupture of the aneurysm into the mucous canal or serous cavity.

13. **Abdominal abscesses.**—The diagnosis of an abdominal abscess may be attended with very great difficulty. The symptoms are a swelling more or less well defined and clearly outlined, fixed to the surrounding structures, painful, tender, of recent and rapid formation, associated with fever, rapid pulse, and leucocytosis. Such an abscess in connexion with *appendicitis* may be met with in the right iliac fossa, the right loin, the pelvis, and even in the left iliac fossa or central part of the belly. Similar abscesses in connexion with ulceration of the cæcum (tuberculous), sigmoid flexure (diverticulitis), or descending colon may be met with in the left iliac fossa and loin. It is when the suppuration occurs in the upper part of the abdomen just beneath the diaphragm, *subphrenic abscess*, that the greatest difficulty in diagnosis occurs. The abscess often contains gas, which gives a tympanitic percussion note, and, as the gas always rises to the top of the pus, the variation in the seat of the tympanitic note with alterations in the position of the patient is a valuable sign. If the pus collects above the liver, that organ is depressed, and the upper limit of the liver dullness is raised by pushing up of the diaphragm. Such an abscess in the epigastric region points anteriorly. On the left side the diaphragm is raised, and the spleen and stomach may be depressed. Abscess beneath the diaphragm often leads to some collapse of the lower lobe of the lung, with pleurisy, pleural effusion, or empyema, or the abscess may burst into the lung. (*See* p. 588.)

CHAPTER XXXVII

DIAGNOSIS OF ACUTE ABDOMINAL AFFECTIONS

There are several acute affections of the abdominal viscera, the symptoms of which are so closely alike that they can only be distinguished by great care. The symptoms common to this group of diseases are *abdominal pain*, *vomiting*, and *collapse*; they come on with more or less abruptness and with varying degrees of intensity. The causes may be—

Appendicitis.
Ruptured gastric or duodenal ulcer.
Ruptured tubal pregnancy.
Torsion of ovarian tumour.
Ruptured pyosalpinx.
Ruptured ovarian tumour.
Acute or gangrenous cholecystitis.
Ruptured gall-bladder.
Ruptured hepatic abscess.
Renal colic.
Displaced kidney.
Torsion of spleen.
Intussusception.
Internal hernia.
Volvulus.
Gall-stone impacted in intestine.
Intestinal colic.
Acute pancreatitis.
Mesenteric thrombosis.
Diaphragmatic pleurisy.
Gastric crisis of tabes dorsalis.
Acute osteo-myelitis of spine.
Cortical abscess of kidney.

To distinguish between these various affections attention should be paid to the following points:

i. **The pain.**—(*a*) *Mode of onset*, whether sudden or gradually increasing in intensity, whether constant or intermittent, whether coming on spontaneously or during some effort. (*b*) *Time of onset*, at what period of the day or night, its relation to food and exercise. (*c*) *Seat*, where first felt, where it subsequently becomes localized, and especially the direction in which the pain shoots. (*d*) *Character* of the pain, whether griping, burning, cutting, or nauseating, and whether it is modified by position, movement, or respiration. (*e*) *Tenderness*, if present and where, whether localized or diffused, slight or intense.

Sudden intense pain is characteristic of ruptured ulcer, appendicitis, ruptured tubal pregnancy, ruptured pyosalpinx, ruptured gall-bladder, and may be met with in intussusception. Pain that very quickly becomes intense is met with in renal and biliary colic, twisted ovarian tumour, intussusception, and diaphragmatic pleurisy. The pain of intestinal colic, internal hernia, volvulus, displaced kidney, and torsion of the spleen more slowly reaches its greatest intensity.

It is a striking fact that appendicitis comes on very frequently in the early hours of the morning while the patients are quietly sleeping: there is no other acute abdominal affection in which this is so frequently the case. If a patient goes to bed feeling quite well and is aroused about 2 a.m. by acute pain about the umbilicus and then vomits, it is nearly always due to the onset of appendicitis. Appendicitis, however, may come on at any other time. Renal colic almost always comes on during the day, and during or shortly after active exercise. Biliary colic is prone to come on during the latter part of the day, or after a full meal. Rupture of a gastric or duodenal ulcer is most likely to come on soon after a full meal, and during some effort. Rupture of a tubal gestation occurs in the daytime, and generally during some effort. Torsion of an ovarian tumour or of the spleen and misplacement of the kidney nearly always occur during the active movements of the daytime. Internal hernia and volvulus also come on during active movement.

Many acute abdominal pains are first felt at or near the umbilicus, and this is especially true of appendicitis, pancreatitis, internal hernia, intussusception, gall-stone impacted in the intestine, and some cases of ruptured ulcer. In some of these cases the pain soon leaves this region: in appendicitis, for instance, it passes down into the right iliac fossa, and in ruptured ulcer it becomes more diffused over the abdomen. Pain beneath the upper part of the right rectus muscle, passing round the right half of the trunk, with tenderness just below the tip of the xiphoid cartilage and at the upper end of the right semilunar line, is characteristic of biliary colic. Pain in the loin and below the false ribs, shooting down into the groin, hypogastrium, penis, testicle, or thigh, is characteristic of renal colic. This may be accompanied by great local tenderness, or may be relieved by firm pressure over the kidney. Pain about midway between the umbilicus and xiphisternum is often due to rupture of a gastric ulcer; the pain may be farther to the left; that of duodenal ulcer is a little to the right of the middle line. The pain of a ruptured tube is felt below the umbilicus, often close above the pelvis; it may be median or to one side. The pain of a twisted ovarian tumour, spleen, or misplaced kidney is over the part, is always accompanied by local tenderness, and in the case of the kidney is always relieved by lying on the back, especially if to this is added gentle upward pressure below the tumour. A twisted spleen may be similarly relieved; while this is always on the left side, a painful displaced kidney is nearly always on the right side.

The pain of a ruptured ulcer is usually described as of a hot, burning character, often agonizing in intensity, and some patients speak of a sensation as of hot liquid flowing down the abdomen. The pain of biliary colic varies in intensity, but is generally a sense of constriction, as if the right side were tightly gripped or held in a vice; it is usually felt acutely in the back, and sometimes also in the right shoulder. The pain of renal colic is a sharp, cutting, lancinating pain; that of displaced kidney, twisted spleen, or ovarian tumour is a gradually intensifying ache. The pain of ruptured gestation is less severe than the others; it may be almost momentary. The pain of intussusception and volvulus is griping in character and intermittent; intestinal colic is also griping, intermittent, referred to the umbilicus, and relieved by pressure. The pain of diaphragmatic pleurisy is felt with each deep inspiration, especially at the end of the act, is sharp, shooting in character, and passes round the side or sides of the trunk to the front, usually about the level of the umbilicus; it may be so severe that the patient feels as if held in a vice on both sides. The tenderness at or near McBurney's spot is a feature of appendicitis; the exact seat of perforated ulcer is often tender, but the diffused tenderness of acute peritonitis quickly follows; intussusception is tender only during the paroxysms of pain; there is some tenderness over a tight internal hernia and over a gall-stone impacted in the bowel. The pain of acute pyosalpinx may closely simulate that of appendicitis, but it is generally more above the pubes than in the iliac fossa, and as severe on the left side as on the right.

2. **Vomiting.**—(*a*) *Time and frequency.* A *single act of vomiting* accompanying the onset of acute pain

is of no diagnostic significance: it is a symptom common to all severe abdominal disasters—the perforation of a viscus, the torsion of a pedicle, the first invasion of the peritoneum, the acute displacement of a viscus—and it may occur at the very commencement of a pleurisy. *Frequent and repeated vomiting* is met with in any form of intestinal obstruction, in acute peritonitis, in renal and biliary colic, and in acute pancreatitis. (*b*) *Character of the act.* In renal and biliary colic, vomiting is attended with nausea and much retching; in intestinal obstruction and in the later stages of peritonitis there is no nausea, and the act is little more than a regurgitation from the stomach, coming on independently of taking food. (*c*) *Vomited matters.* In perforation of a gastric ulcer a little bright blood may be mixed with the food; in colic, or torsion of a viscus, or appendicitis the vomit becomes bilious; in peritonitis it becomes dark brown or black and flocculent from admixture with altered blood; in intestinal obstruction it is alkaline and consists of the regurgitated contents of the bowel; the longer the obstruction lasts, and the more acute the symptoms, the lower down the bowel the vomited matter comes from. Regurgitant vomiting is often incorrectly spoken of as "fæcal"; it is really fæcal only in the late stage of obstruction in the large bowel, or in cases of ulceration between the colon and the stomach.

3. **Collapse.**—Besides the intensity of the collapse, which is a measure of the gravity of the catastrophe, the time of onset, its progressive increase, and the coexistence of marked anæmia are the points especially to notice. Severe initial collapse most often occurs in perforation of a viscus—stomach, duodenum, appendix, tube, gall-bladder. Increasing collapse may be caused by pain, as in severe renal or

hepatic colic, or by hæmorrhage, as in ruptured tubal gestation. Collapse comes on late in intestinal obstruction and peritonitis. The subjects of gastric ulcer may be anæmic from a previous hæmorrhage, and this fact may aid in the diagnosis; but if a patient becomes blanched during the acute illness, with all the signs of acute anæmia, it is strong evidence in favour of a ruptured tubal gestation. It is important to remember that the collapse caused by apparently similar lesions may vary widely—a perforated ulcer may cause almost instantly fatal collapse, or only trivial and fleeting shock; the same is true in greater or less degree of the collapse from intussusception, internal hernia, colic, and appendicitis. In cases of ruptured ulcer and appendicitis there is often a misleading calm following a temporary collapse and preceding the development of peritonitis; in acute pancreatitis the collapse is always pronounced.

4. **Pulse and temperature.**—The frequency and loss of tone in the pulse depend chiefly upon the severity of the abdominal disaster and not upon its seat or nature. As a rule, the pulse is much less affected by acute salpingitis than by acute appendicitis, while it may very rapidly become uncountable at the wrist in a case of ruptured tubal pregnancy with severe hæmorrhage. The temperature is less trustworthy as a guide to diagnosis than is the pulse—it is lowered in shock from a ruptured viscus and in severe hæmorrhage; it is raised in inflammations, but it may be normal or subnormal in some of the worst cases of gangrenous appendicitis.

5. **Rigidity of the abdominal wall** and suspension of abdominal respiration is invariably a serious symptom. It is the muscular reflex expression of peritoneal hyperæsthesia, and is seen especially in ruptured ulcer, appendicitis, and peri-

tonitis. The hard retracted abdomen of lead colic is well known; but in biliary, renal, and common intestinal colic, in intestinal obstruction, in twisted viscera before the onset of peritonitis, and in ruptured tube it is not so marked. It may be well marked in diaphragmatic pleurisy owing to the intense pain caused by any descent of the diaphragm. Difference in the rigidity of the abdominal wall above and below the navel, or on the two sides of the abdomen, is to be carefully noted: when localized it indicates a lesion beneath the immobile part. This sign is often present in appendicitis, biliary colic, ruptured ulcer, and ruptured tube. Abdominal rigidity is the most constant of all the symptoms of peritonitis, but even this is very occasionally absent in this disease, whose symptoms vary so much. There is usually an absence of muscular rigidity in acute pancreatitis.

6. **Tumour.**—The abdomen should be carefully and gently examined for a tumour, and the exact position, shape, size, and tension of any tumour found noted, together with its relation to the resonant viscera. By this means an *ovarian* tumour may be found rising up from the pelvis—lying perhaps in one iliac fossa if small, and, if on the right side, simulating the swelling of appendicitis; it will be noticed, however, immediately at the onset of the attack, and not gradually formed as in appendicitis. If the cause of the trouble is torsion of its pedicle, the ovarian tumour will be tense and tender, and it will increase in size. If, however, rupture of an ovarian cyst is the accident that has occurred, the tumour will be smaller than before, less tense, not especially tender, and there will be signs of free fluid in the peritoneum. An ovoid or globular, tense, tender tumour in the right loin or iliac fossa, which

can be pushed up beneath the false ribs with relief to the patient, will be recognized as a *renal* tumour. An ovoid tumour, tense and tender, in the left side of the belly, beneath the rectus, may be the *spleen* with torsion of its pedicle; if a notch can be felt in one edge, or if it can be reduced beneath the left false ribs, this diagnosis will be confirmed. A rounded, tense swelling beneath the upper part of the right rectus muscle, extending up to the costal margin, moving with the descent of the diaphragm, tender, dull on percussion, will be recognized as a distended *gall-bladder*. A tumour which can only be felt at times, hardening under the fingers, and associated then with pain, tenderness, and perhaps nausea and vomiting, is *intestinal*. In the intervals between the active peristalsis which makes it readily palpable, little or nothing can be felt, and there may be neither pain nor tenderness. It may be evidently an intussusception, or a greatly distended coil of intestine from volvulus, or several such coils from some other form of intestinal obstruction. Intussusception is more often felt near the centre of the abdomen; a volvulus is especially frequent in the left iliac fossa. A tumour just rising up over the brim of the pelvis may be a *tubal gestation* or a *pyosalpinx*. An ill-defined, slightly tender swelling deep in the abdomen may be an *internal hernia*. A considerably distended *appendix* may sometimes be felt in the right iliac fossa at the very outset of the acute illness; later on in an attack of *appendicitis* with circumscribed peritonitis a firm, tender, fixed swelling will be recognized in the lowest part of the right iliac fossa, on its inner or outer side, or reaching up towards the loin. Some fullness at the epigastrium may be all that is noticed in *acute pancreatitis*.

7. **Percussion results.**—Four points are to be investigated:

(*a*) **Free gas** in the peritoneal cavity due to perforation of some part of the alimentary canal. If quite small in amount it is generally shut in close around the perforation, and gives a very tympanitic note at that spot, e.g. the epigastrium, or right iliac fossa. If more abundant it will separate the liver from the surface and diminish or abolish the normal liver dullness; it will then give the bell-sound on auscultation. It must be borne in mind that a distended transverse colon will push up and narrow the area of liver dullness. When it is plain that there is free gas in the peritoneum, it is a very important sign of perforation of stomach or intestine.

(*b*) **Free fluid** in the peritoneal cavity at the onset of the acute illness is evidence of rupture of a cyst or of hæmorrhage, or possibly of the escape of a large amount of liquid from the stomach, duodenum, or gall-bladder. The dullness from hæmorrhage due to a ruptured tubal gestation appears first just above the pubes, then extends into the iliac fossæ and the loins. Dullness from a ruptured ovarian cyst is in each loin, unless adhesions limit it to one loin. The contents of a ruptured gall-bladder pass chiefly into the right loin. The contents of the stomach escaping from an ulcer on the anterior surface pass mostly into the left loin; food escaping from a perforation in the left end of the stomach may cause dullness beneath the left false ribs; chyme escaping from the duodenum passes chiefly into the right iliac fossa; a perforation of the posterior wall of the stomach may distend the lesser sac of the omentum and cause an area of dullness in the central regions of the abdomen, with resonance all around it.

(*c*) **Tympanites,** or accumulation of gas within the alimentary canal, may be general, and indicate a widespread peritonism or peritonitis or an obstruction low down. Or it may be local as in acute dilatation of the stomach, a large volvulus, or a local peritonitis. An internal hernia is less resonant than the surrounding intestine.

(*d*) **Local dullness** indicates either a collection of fluid, of food, of blood, or of pus, the displacement of a solid organ, or the presence of a tumour.

8. **Pelvic examination** is especially important in women, as it enables us to recognize the swelling of a tubal gestation or of a pyosalpinx in one or other broad ligament, and the tense swelling of a rotated ovarian tumour, especially when this is so small as to be mainly a pelvic tumour. In both sexes we can occasionally feel an enlarged appendix on the right side, or, later on in the case, the fixed tender swelling of a pelvic periappendicular abscess In cases of intestinal obstruction high up, empty coils of small bowel may be felt filling the fossa in front of the rectum, and when felt they are very important evidence of obstruction. The finger in the rectum, too, can feel blood filling out Douglas's fossa, or appreciate the acute tenderness caused by pelvic peritonitis.

9. **Previous history.**—The previous history of the patient is often of great importance, and should always be inquired into.

(*a*) **Sex.**—Not only are certain of the affections we are considering—tubal gestation, pyosalpinx, and twisted ovarian tumour—limited to the female sex, but biliary colic, rotation of spleen, and displacement of the kidney are more common in women than in men; acute pancreatitis, perforation of a duodenal or gastric ulcer, and renal colic are more common in men.

(*b*) **Age.**—Appendicitis may occur at any age, from infancy to extreme old age, but it is most common in children and adolescents, and is by far the most common cause of sudden abdominal illness at this period of life; indeed, it is almost the only cause in boys and young men. Rupture of a gastric or duodenal ulcer is common between the ages of 25 and 50, and occurs in men more commonly than women. Ovarian tumours may be met with at any age, and even girls before puberty may be the subjects of rotation of the pedicle. Tubal gestation is, of course, limited to the child-bearing period of life, and pyosalpinx is chiefly met with in young adults. Biliary colic may occur in children, but is most common at and after middle life, and intestinal obstruction from an impacted gall-stone is almost limited to middle-aged women. Acute intussusception is chiefly met with in young children, and internal hernia is met with at an early age. Renal colic is most common in middle-aged adults.

Speaking broadly, then, we may say that an acute abdominal illness is most probably due in children to appendicitis or intussusception; in adolescents, to appendicitis, internal hernia, or rotated ovarian tumour; in young women, to appendicitis, ruptured tubal gestation, or pyosalpinx; in young men, to appendicitis or internal hernia; in middle-aged women, to appendicitis, ruptured tube, ruptured ulcer, biliary colic, or displaced kidney or spleen; in middle-aged men, to renal colic, lead colic, appendicitis, ruptured duodenal or gastric ulcer, or pancreatitis.

(*c*) **Occupation.**—Workers in lead are liable to severe intestinal colic; the gums should be examined for a blue line. Acute pancreatitis is commoner in stout alcoholics, such as barmen, brewers' draymen etc.

(*d*) **Previous condition.**—Under this heading there are three or four important points. Inquiry should first of all be directed to the existence of slighter symptoms of disease before; the existence of even slight previous indigestion may serve to indicate the cause of a sudden severe abdominal illness. Thus a previous attack of appendicitis, or the occurrence of sudden sharp fleeting pain in the right iliac fossa, would indicate a diseased appendix. Pain soon after food, relieved by vomiting, and perhaps hæmatemesis, would be evidence of gastric ulcer. If the pain has come on from one to two hours after food, has been relieved for a time by taking food, and especially if there has been melæna with or without hæmatemesis, it will indicate a duodenal ulcer. Flatulent dyspepsia with pain—often severe pain, called "the spasms"—coming on after meals, especially in the latter part of the day, and referred to the upper part of the abdomen, and more especially on the right side, and to the right shoulder, would be evidence of the existence of gall-stones; further corroboration is often afforded by the patients saying they have suffered from a feeling of constriction in the upper abdomen—leading a woman to remove her corsets, for instance. A history pointing to the presence of gall-stones, or of chronic indigestion with obesity and chronic alcoholism, is often met with in cases of acute pancreatitis. In some cases of internal strangulation the patient gives a history of previous attacks of colic, or of slight fleeting obstruction; but in many cases there has been no premonitory symptom of any kind. Previous pricking, or more severe, pain in one loin, possibly shooting down the side, or "neuralgia" of the testicle, or hæmaturia, or frequent micturition would suggest the presence of a stone in the kidney. A loose kidney or spleen has almost always caused slighter attacks of the same kind before a severe attack of pain comes on. This does not hold good of rotation of an ovarian tumour—there may have been no previous symptoms whatever, in other cases the tumour has been large enough to be noticed; in cases of rupture of an ovarian tumour the abdominal swelling has always been previously noticed, and usually has been of great size. The existence of a tumour beneath the upper part of the right rectus muscle has sometimes been noticed before the onset of symptoms due to rupture of gall-bladder. In women of child-bearing age special inquiry will be made in reference to the catamenia, previous pregnancies, irregular uterine hæmorrhages, vaginal discharge, and pelvic pain; the breasts must be examined for signs of pregnancy. Tubal gestation may occur in a first pregnancy, but it rather frequently follows upon a period of sterility in a married woman. One or more missed periods, or a very slight loss at the time when the period was due, are significant signs of tubal pregnancy. The breasts may show no signs of pregnancy, but if they contain milk, or the areolæ are dark, these would be valuable indications of pregnancy. A purulent vaginal discharge and pelvic pain would suggest the presence of pyosalpinx.

A previous abdominal operation is an important point; it may have left adhesions, causing kinking or strangulation of the bowel. After a recent operation a deep abscess may have suddenly extended or burst.

10. **Action of bowels.**—With the oncoming of acute appendicitis there is often one, sometimes there are two or three loose evacuations from the bowel. In acute intussusception there is frequent straining

at stool, and the passage of mucus and blood; this may occur with each paroxysm of pain. In volvulus the patient may make wholly ineffectual, straining efforts at defæcation during the paroxysms of pain. The absolute constipation of acute intestinal obstruction of all kinds is characteristic. The previous and existing constipation attending lead colic is, of course, to be noted. Bloody, very putrid stools are suggestive of mesenteric thrombosis.

11. **The urine.**—Frequency of micturition is often associated with renal colic. The urine may contain blood, or crystals of uric acid or oxalate of lime, in renal colic; if it contains much indican it shows that there is intestinal obstruction. The detection of lead in the urine would support a diagnosis of lead colic.

12. **Blood-count.**—The effect of a severe hæmorrhage will be shown in a marked diminution of the number of red cells, but unless the bleeding is severe, and therefore recognizable by other signs, the change will not be so pronounced as to be of diagnostic value. Polymorphonuclear leucocytosis is met with in acute and in gangrenous appendicitis, in pyosalpinx, cholecystitis, pancreatitis, and in peritonitis from any acute infection; it is not found in the early stage of a perforated ulcer, ruptured tube, or rotated viscus, nor in renal, biliary, or lead colic. But if the toxæmia is so severe as to inhibit this reaction, as in some of the worst cases of gangrenous appendicitis, leucocytosis is absent.

13. **Examination of the chest.**—In any case of acute abdominal pain in which the symptoms of disease in the abdomen are equivocal, or the character and rate of the respiration suggest disease of the lungs or pleura, the chest should be carefully examined for abnormal dullness, friction, alteration

in the intensity and character of the breath-sounds, and for crepitation. At the onset of pleurisy or pneumonia the typical physical signs may be absent.

14. **X-rays.**—Urinary calculi, unless consisting of pure uric acid, can be shown in a skiagram, and under favourable circumstances a very good skiagram will show certain gall-stones and appendicular stercoliths—those that contain lime salts. The outline of the kidney, spleen, and liver, and of uterine, ovarian, and gall-bladder tumours, as well as of abscesses, can also be seen. In most cases there is no time or opportunity to get a sufficiently good skiagram to be of real value in the diagnosis.

15. **Nervous phenomena.**—Inquire for a history of "lightning pains" in the legs, and of ataxy. Test the knee-jerks, and the reaction of the pupils to a bright light. If gastric crises occur at all in a case of locomotor ataxy, they are usually recurrent.

It is impossible to exaggerate the need for care in this class of case, if on the one hand the golden moment for treatment is not to be lost, and on the other hand the patient is to be saved from an uncalled-for operation. Special attention should be paid to the suddenness of the onset of the illness, to signs of grave interference with function, to physical evidence of severe lesion, to the history of previous illness, and to the assured absence of signs of pulmonary or spinal-cord disease. It is not possible to represent all the many combinations of symptoms that may be met with, but it may be useful to state broadly the **evidence on which a diagnosis is arrived at** in a large number of cases.

1. When a patient is seized with sudden pain at the epigastrium, which soon passes down into the right iliac fossa, and is associated with tenderness in the iliac fossa from the first, the case is one of acute **appendicitis.** If the attack comes on in the early morning hours, and in one who appeared to be at the time quite well, or had suffered previously either from appendicitis, or slight occasional sudden pains in the same region, the diagnosis is still more certain. There may be vomiting, and one or even more loose motions, at the outset of the illness. In some cases there is very slight, or no tenderness in the right iliac fossa, but there are found tenderness and some muscular rigidity in the right loin, or on rectal examination tenderness is elicited by pressure on the right side of the pelvis, or pain is produced when the hip is fully rotated inwards whereby the obturator internus muscle is stretched. Having arrived at this diagnosis, the surgeon may further endeavour to determine what form of the disease he has to deal with.

If the initial symptoms are very severe, especially if the pulse-rate is high, and vomiting persists, if the facies is "abdominal," the abdomen motionless, and there is no swelling or lump to be made out in the iliac fossa, loin, or pelvis, it is a case of **gangrenous or perforative appendicitis.** Marked leucocytosis at the onset of the attack would confirm this diagnosis. The development of general peritonitis, if the case is seen later, would only too cogently confirm the diagnosis. The temperature may be normal, subnormal, or raised; it affords no aid to the diagnosis.

If quickly after the onset of the pain a swelling or circumscribed resistance can be made out around the appendix, and if muscular rigidity and tenderness are limited to the right lower quadrant of the abdomen, and the temperature is raised, the pulse is moderately quickened, and there is moderate leucocytosis, there is a **circumscribed plastic peritonitis around the appendix.** When in such a case rest in bed has been followed by a gradual improvement in all the symptoms, *resolution* has set in.

But when the swelling persists—still more if it increases—and the pain and the tenderness grow more acute, and blood-counts show an augmenting leucocytosis, and the temperature rises, especially if it rises after previous lysis, there is **suppurative appendicitis** or a **periappendicular abscess.** Surface redness and œdema, or even distinct pointing, may make this condition very evident. Rectal tenesmus with proctorrhœa—a discharge of a large quantity of mucus from the rectum—is often a sign of an abscess near, and about to burst into, the rectum; and very frequent and very painful straining micturition may indicate an abscess near and involving the bladder wall. As a rule the pulse-rate rises with the occurrence of suppuration, but exceptions occur. The abrupt onset of appendicitis usually serves to distinguish it from local tuberculosis, which in other features may resemble it.

When the case is first seen the signs and symptoms may be those of general peritonitis, and the diagnosis of the causative appendicitis will rest upon the history of the situation of the initial pain, or of previous mild attacks.

2. If a patient is suddenly seized with severe epigastric pain shortly after a meal and while making some slight effort, with perhaps an immediate act of vomiting, and collapse is well marked, and on examination the upper abdomen is immobile, rigid, very tender at the epigastrium, **perforated ulcer** may be diagnosed. A distinct history of gastric ulcer, a little blood in the vomit, the demonstration of free

gas in the peritoneum, the absence of all tenderness in the right iliac fossa and of swelling in the pelvis, will support the diagnosis of *perforated gastric ulcer*. If the same symptoms—pain, vomiting, collapse—come on two to three hours after a meal, and particularly if the patient is a man who gives a history of duodenal dyspepsia, and the seat of greatest tenderness is to the right of the middle line, a *perforated duodenal ulcer* may be diagnosed. Pelvic examination as a rule reveals in both these conditions acute tenderness due to early inflammation of the pelvic peritoneum set up by the free gastric or duodenal contents.

3. If a woman of child-bearing age is suddenly seized with severe pain in the hypogastrium, becomes faint, then vomits, and on examination acute tenderness with or without a swelling is found in one broad ligament on rectal or vaginal examination, and she has become blanched and anæmic since the pain came on, and there is a history of one or more missed periods, with perhaps some irregular uterine hæmorrhage, a diagnosis of **ruptured tubal gestation** may be made. If free fluid is demonstrable in the peritoneal cavity, or if the breasts show signs of pregnancy, the diagnosis is made clearer.

4. If a young girl or woman who is seized with sudden severe pain in the lower abdomen, vomiting, and more or less collapse is found to have a tense, tender tumour in the lower abdomen, it is probably an **ovarian cyst with twisted pedicle.** If it is movable at all, or is wholly within the abdomen, or of large size, or with evident fluctuation, this diagnosis is established.

A **small ovarian cyst,** the size of a hen's egg or a lemon, connected with the right ovary, when its pedicle is twisted may come to lie in the right iliac fossa, and closely resemble an appendicitis tumour. It occupies the same position, is equally tender, the belly-wall over it is motionless and rigid, the temperature and pulse are raised, there may also be vomiting and constipation. A diagnosis can be arrived at if the tumour is noticed at the very commencement of the illness, or if it is found to be movable within the abdomen, to be very tense and to have a well-defined outline. In a doubtful case examination under an anæsthetic would reveal its mobility and establish the diagnosis.

5. If, in a young or middle-aged woman who complains of acute abdominal pain, and is feverish, there is found a pelvic swelling, seated in one or in both broad ligaments or behind the uterus, fixed to the uterus, which is partially fixed by the swelling, and pain is produced by attempts to move the uterus, and if there is evidence of purulent vaginal discharge, it is a **pyosalpinx** with actual or threatened rupture or extension of inflammation to the peritoneum.

Similar pain and fixity with pain on movement of the uterus without a definite swelling suggest acute salpingitis. In both these conditions the temperature may be high, but as a rule the increase in the pulse-rate is much less than with the same degree of fever caused by appendicitis or peritonitis.

6. If a woman known to have an abdominal tumour, or possibly only known to have a prominent, tense abdomen, when making some effort or movement experiences pain in the belly, vomits, and becomes somewhat collapsed, and on examination the tumour is seen to be less prominent, or a flaccid tumour, or a flaccid part of a tumour, is found, and there is free fluid in one or both loins, the diagnosis of **ruptured ovarian cyst** is justified.

7. When a patient of middle age who has for a

long time suffered from "spasms" or flatulent dyspepsia, with pain especially in the right hypochondrium, is seized with severe cramping pain at the epigastrium, passing round the right side to the back and right shoulder, with a sense of severe constriction in this region, vomits repeatedly, and becomes collapsed, and there is found acute tenderness in the middle line a little below the xiphoid cartilage, it is **biliary colic**. There may be a history of similar previous attacks with the finding of gall-stones in the motions, or there may be tenderness over the gall-bladder, or signs of a distended gall-bladder, to confirm the diagnosis. Jaundice with clay-coloured stools and bile in the urine may come on if the stone passes into the common bile-duct, or if inflammation extends from the cystic to the common bile-duct. Biliary colic may occur in younger patients.

8. When a patient is seized with severe epigastric pain and vomiting, and is found to be febrile, to have a moderately distended abdomen, and acute tenderness below the eighth and ninth costal cartilages on the right side as well as just below the xiphoid cartilage, and a rounded, tense tumour or less well-defined resistance can be felt beneath the upper part of the right rectus muscle, it is a case of **acute cholecystitis**; a history pointing to the presence of gall-stones can usually be obtained. There is leucocytosis. If the patient is very obese the tumour cannot be felt. The symptoms are less severe—there is less collapse—and the pain and tenderness are more limited to the right side than in acute pancreatitis.

9. When a patient known to have gall-stones, or a distended gall-bladder, or in whom the history points strongly to such, is seized with sudden severe

pain over the gall-bladder, vomiting, and shock, and on examination the whole abdomen is found motionless, and the enlarged gall-bladder can no longer be recognized, and free fluid is present in the peritoneum, **rupture of the gall-bladder** is to be diagnosed.

10. Or if a patient known or suspected to have an abscess or hydatid tumour of the liver, with great enlargement of that organ, has sudden severe pain and becomes collapsed, and there is evidence of free fluid in the peritoneum, **rupture of hepatic abscess** or of a **hydatid** will be recognized. It may be possible to make out a marked diminution in size of the liver simultaneously with the escape of fluid into the peritoneum.

11. When a patient is seized with severe and increasing sharp, cutting pain in one loin just below the last rib, and the pain shoots down into the groin, penis, testicle, or thigh, perhaps becomes agonizing in intensity, and is then associated with vomiting, or a rigor, cold sweat, and collapse, **renal colic** is to be diagnosed. Frequent micturition, a little blood in the urine, retraction of the testicle, the coming-on of the pain in the day-time, and a history of previous attacks of the same kind, or of the passage of gravel or of crystals in the urine, would support the diagnosis.

12. When a woman during active movement or effort experiences pain below the right ribs, and this pain steadily increases up to an agony and is then associated with vomiting and shock, and on examination a firm, very tender tumour is found in the right loin or iliac fossa, which can be moved upwards under the ribs, and the patient is then relieved, a diagnosis of **displaced kidney** with kinking of the ureter or torsion of the renal vessels can be made. A history of previous attacks or of slighter pain in the same

situation, always coming on when upright, and always relieved by lying upon the back and relaxing the abdominal walls, would support the diagnosis.

13. When a woman while making some effort is seized with pain in the left side of the abdomen about the level of the umbilicus, which steadily increases and brings on vomiting, and on examination a firm, tender tumour is felt in the situation of the pain, and the tumour can be pressed up beneath the left false ribs, and especially if a sharp or notched border can be recognized in it, it is a case of **displaced spleen with torsion** of its "pedicle." The patient may state that she was conscious of something slipping out of place, or that she had previously had minor attacks of the same nature.

14. If an infant or young child is suddenly seized with severe abdominal pain, and vomits, and the pain is noticed to come on in paroxysms, and there is a frequent passage of mucus, and perhaps blood, from the rectum, and on examination an elongated tumour is felt in the centre or towards the left side of the abdomen, hardening up under the finger during each paroxysm of pain and then softening or even disappearing, and the right iliac fossa feels unusually empty, it is **intussusception.** In rare cases the end of the intussusception can be felt per rectum.

15. When a patient is seized with vomiting, which is frequently repeated and becomes intestinal, and neither motion nor flatus is passed from the rectum, and an enema, if it returns, brings no motion or flatus with it, and purgatives if given and retained have failed to act upon the bowels, and the urine is loaded with indican, there is **acute intestinal obstruction.** Pain may be absent, or slight, or severe. There may be nothing else to be made out in the case until fatal collapse or signs of peritonitis develop. But

there may be a more or less definite or ill-defined abdominal swelling, or collapsed coils of ileum in the pelvis, or a distended coil of bowel in the abdomen, or distended coils of small intestine and an empty colon. For the further diagnosis of cases of intestinal obstruction, *see* Chap. XXXVIII.

16. When a worker in lead who has a blue line along his gums and lead in his urine is seized with severe griping pain referred to the umbilicus, and there is obstinate constipation and a hard retracted abdomen, he is suffering from **lead colic.**

17. When a patient is seized with vomiting, griping abdominal pains, and diarrhœa, with gradually increasing collapse, and there is no marked local abdominal tenderness, it is a case of **irritant poisoning.** Usually several members of a party or of a household are simultaneously attacked, and soon after taking some particular article of diet, e.g. sausage, tinned meat, etc.

18. When a patient complains of severe constricting pain in the upper abdomen, and the belly-wall is found to be motionless but neither retracted nor distended, and the pain becomes very acute at the end of a deep inspiration when the diaphragm descends, and there is no tenderness or altered percussion note at the epigastrium, the case is most probably one of **diaphragmatic pleurisy**; the detection of friction will confirm the diagnosis. If one side of the chest is dull, and the breath-sound is absent or tubular, it is a case of **lobar pneumonia.**

19. If a stout patient who has had symptoms of gall-stones or of rather severe indigestion is suddenly seized with severe pain at the epigastrium, persistent vomiting, and marked and increasing collapse, accompanied by unusual cyanosis and extreme rapidity of the pulse, and on examination the

abdomen is found distended but with flaccid walls, with tenderness on pressure above the umbilicus and possibly some ill-defined fullness or resistance in this situation, it is a case of **acute pancreatitis.** The symptoms of this affection are obscure: in some hæmorrhage occurs, in others there are peritonitis and gangrene; leucocytosis is present from the first. The patients are usually chronic alcoholics.

20. If a patient is suddenly seized with acute abdominal pain, and collapse, cannot pass fæces or flatus, and the abdomen becomes rapidly distended by a resonant tense and tender swelling, it is a case of **acute volvulus.** In this variety of acute obstruction vomiting may be slight or altogether absent.

21. If a patient is seized with sudden severe abdominal pain and vomiting, and passes bloody, putrid stools, and becomes collapsed, **thrombosis of the mesenteric vessels** has probably occurred. The existence of old heart disease and arterial degeneration would support this diagnosis.

22. When a patient is seized with pain in the central part of the abdomen, followed by vomiting, increasing abdominal distension, fever, quick pulse, and leucocytosis, and there is no localized pain or tenderness, nor local swelling, nor is there intestinal obstruction, the case is one of **acute peritonitis** due to immediate infection of the serous membrane, e.g. by pneumococcus, streptococcus, or gonococcus.

23. If a man is suddenly seized with severe abdominal pain, vomiting, and collapse, and it is found that his pupils are small and do not react to light, that his knee-jerks are diminished or absent, and that he has had "lightning pains" in his legs, it is a **gastric crisis** in the course of a case of tabes dorsalis. There may be a history of previous attacks to support the diagnosis.

24. The rare condition of **acute osteo-myelitis of the spine**, when it attacks the lumbar vertebræ, may be mistaken at its onset for an acute abdominal catastrophe. It is characterized by very intense pain and tenderness in one or both loins, the pain rapidly extending round the trunk as a girdle pain. With this there are all the signs of an acute toxæmia, fever, dry tongue, thirst, etc. It is to be distinguished, however, from an abdominal condition by the absence of abdominal signs corresponding with this degree of toxæmia.

25. Certain cases of **cortical abscess of the kidney** are acute in onset, with fever, rapid pulse, and pain. The pain is situated in one or other loin, extending down to the iliac fossa. There will be tenderness over the kidney either in front or behind. The condition will be diagnosed from appendicitis or cholecystitis, etc., by the exact site of the tenderness and the want of correspondence between the general condition of the patient and the abdominal signs.

CHAPTER XXXVIII

DIAGNOSIS OF CASES OF INTESTINAL OBSTRUCTION

Cases of intestinal obstruction fall into two distinct groups: (1) those in which a sudden cessation of the passage of fæces and flatus is the main symptom, and (2) those in which the difficulty in obtaining a satisfactory emptying of the bowel is of a chronic and progressive character. The first class of case is given the name of *acute*, the second is known as *chronic*. In a number of the acute cases, the history makes it clear that the final acute stage is but the culmination of a chronic affection, and to these the designation of *acute obstruction upon chronic* is sometimes given. As the discharge of fæces and flatus depends upon the action of the intestinal muscle, it can be arrested either by failure of peristalsis or by mechanical obstruction. The clinical term "intestinal obstruction" should be limited to the latter class of cases, and will be so used here. Cases of intestinal paresis from peritonitis, or of congenital dilatation of the colon (Hirschsprung's disease), are not included.

A. **Acute intestinal obstruction.**—This condition will be recognized by the combination of four symptoms—(1) complete cessation of the normal intestinal discharge of fæces and flatus, (2) distension of coils of gut above the point of obstruction, (3) severe colicky pain, (4) regurgitant vomiting. As a result of the absorption of the retained intestinal contents and their excretion by the kidneys, the urine becomes heavily charged with indican, and turns black upon the addition of a strong mineral acid. There may be more or less well-marked shock, due to the irritation of the nerves, especially their tight compression, symptoms of toxæmia and, if vomiting is severe, of collapse from loss of fluid, and the patient may show the effects of a chronic disease which has culminated in intestinal obstruction, e.g. cancer of the colon or rectum. The constipation of obstruction is what is known as "absolute constipation": neither motion nor flatus is passed spontaneously, the bowel does not react to a purgative, and an enema fails to bring away anything beyond, at times, just a very little flatus, or tiny portions of motion which have been lying in the bowel below the obstruction. Regurgitant vomiting is recognized by the absence of nausea and of great straining effort—the stomach appears to empty itself quite easily. The first vomit consists, as in all cases, of the usual contents of the stomach; in intestinal obstruction the vomited matter quickly becomes alkaline and definitely intestinal, and later it may become fæcal. As a rule, great urgency of vomiting and but limited distension indicate obstruction high up in the bowel.

Having arrived at the conclusion that the patient is suffering from acute obstruction, the next step in the diagnosis is to determine whether there is any **external hernia.** The usual and also the unusual seats of hernia must each and all be carefully examined; and if a tumour is found, which is fixed to the belly-wall, tense, and dull on percussion, it is to be regarded as a *strangulated hernia.* Should the surgeon be in doubt as to whether a given swelling is a hernia or not, when there are symptoms of acute obstruction, he should explore the swelling by operation. If no hernial tumour is detected, inquiry should be made as to whether the patient is the subject of a hernia which has been reduced, and, if so, what relation as regards time the onset of the symptoms of obstruction had to the reduction of the hernia, and whether the reduction offered any difficulty. It must be remembered that a patient may himself accomplish a *réduction en bloc* of a hernia, and without noticing any difficulty whatever in the taxis. When, then, it is known that the patient is the subject of a reducible hernia, the ring and hernial canal should be very carefully examined, and it may even be justifiable to endeavour to get the rupture to descend to make certain that it is not the seat of the obstruction.

If the surgeon is able to exclude altogether external hernia, the problem then is to distinguish between the various forms of **internal strangulation.** In a large number of cases it is impossible to determine the exact cause of the strangulation without actual exploration of the abdominal cavity; intussusception is capable of more certain diagnosis than any other form of acute internal strangulation. When, early in the case, the collapse is very marked, the pulse being small and feeble, and the skin cold and bathed in sweat, it indicates *tight strangulation.* When vomiting sets in early, is frequently repeated, and quickly becomes intestinal, and the belly is uniformly and only moderately distended, and the excretion of urine is small, the obstruction is known to be seated in the *small intestine*, and the higher up the strangulation the more marked are these distinguishing features. When, on the other hand.

the abdomen is greatly distended, and the vomiting is less urgent, and a longer interval elapses before it becomes intestinal, it indicates that the obstruction is in the *large intestine.* In these cases it may be possible to see or to mark out by percussion the cæcum and colon, and when the obstruction is in or near the transverse colon the right loin may be much more distended than the left.

The following forms of internal strangulation are to be distinguished, viz. *intussusception*, *internal hernia*, and *volvulus*.

In cases of acute intestinal obstruction there is no advantage for purposes of diagnosis to be derived from the administration of copious or repeated enemata, or from attempts to pass a long rectal tube.

If an elongated tumour is felt in the position of the cæcum, or in the course of the colon, and if there is frequent tenesmus, with a discharge from the anus of bloody mucus or even of pure blood, *intussusception* is to be diagnosed. The tumour will be noticed to become alternately more and less firm and apparent, its periods of firmness being accompanied by griping pains and tenesmus. This periodic hardening of the tumour is due to strong peristalsis, and is an evidence of the muscularity of the swelling. In some cases the lower end of the strangled bowel may be felt in the rectum, or it may even be extruded beyond the anus.

If the patient has been suddenly seized with localized pain in the belly which has rapidly become greatly distended, and a rounded tense swelling or tumour can be detected in either iliac fossa or flank, the obstruction may be diagnosed as a *volvulus.* Vomiting may be slight or absent in obstruction due to this cause. This condition is met with more frequently in the large than in the small bowel, and particularly in the cæcum or in the sigmoid flexure, and the twisted part may be enormously distended and be visible through the abdominal walls.

When there is but moderate distension of the abdomen, and no tumour or swelling or seat of special resistance can be detected, and, further, when the vomiting sets in early and quickly becomes intestinal, the case may be diagnosed as one of *internal hernia*, or of strangulation of the bowel by *a band*. If there is an old hernia, or a history of some previous attack of peritonitis, or of an intraperitoneal operation such as ovariotomy, it would point to the presence of a *band*. If the patient has been subject to attacks of colic, and if there is ill-defined local resistance or fullness, especially in either iliac fossa, it points to *internal hernia*.

If a patient who has been suffering from jaundice, pain in the hepatic region, sickness, and other symptoms of gall-stones suddenly exhibits signs of acute intestinal obstruction, the condition may be attributed to *impaction of a gall-stone in the bowel*.

The diagnosis of these causes of acute intestinal obstruction is also considered in Chapter XXXVII.

B. **Chronic intestinal obstruction** is most frequent in the large intestine, and, particularly, near its lower end.

Chronic intestinal obstruction must be first of all distinguished from *chronic constipation*, in which, at long and irregular intervals, full-sized and often very large and hard fæcal masses are passed. *Fæcal impaction* is another condition not to be confused with chronic obstruction; it may occur at any part of the colon, but particularly in the cæcum, at either of the flexures, or in the pelvic colon; in the worst cases the whole of the large bowel may be choked with fæces. In the abdominal colon fæcal masses are felt as rounded or uneven lumps, which may be indented by the fingers, are often resonant on percussion and slightly tender, and under treatment can be traced moving along the colon, or gradually melting away. The finger in the rectum at once detects fæcal masses in the pelvic bowel.

A case of chronic intestinal obstruction should be investigated as follows: First of all a careful history of the case should be obtained, attention being paid particularly to the character and frequency of the motions—to the size, shape, and amount of the fæcal matter passed, and to the admixture with mucus and blood. The size of the motion is an index of the lumen of the lower part of the large bowel; if a stricture is high up in the colon the fæcal matter that passes through it may be re-formed into larger masses in the lower colon before it is discharged. The progressive diminution of the size of the motion is an important sign of increasing contraction in the lumen of the bowel. The presence of mucus in the motion is an indication of hyperæmia and irritation of the mucous membrane, and the presence of blood is the result of more intense congestion or of ulceration of the mucous membrane. When the mucous discharge is abundant it may be passed frequently and give the patient the impression that he is suffering from diarrhœa. In some cases of very vascular growths of, or penetrating into, the colon, the discharge of mucus is extraordinarily copious. The irregularity of fæcal discharge should be noted; the arrest of all discharge for some days, followed by the frequent passage of very loose or soft and small motions, is a significant sign of organic obstruction; this is spoken of as alternating constipation and diarrhœa. The passage of several unsatisfactory motions in the early hours of the day—"morning diarrhœa"—followed by quiescence of the bowel for the rest of the day, is frequently observed in the earlier stages of cancer of the lower bowel. A history of colicky pains with gurgling in the bowel is an indication of vigorous but ineffectual contractions of the bowel above an obstruction. Any history of previous operation or attacks of peritonitis should, of course, be carefully noted.

After obtaining the history of the case the surgeon should carefully examine the patient and specially note the following points:

1. **Distension.**—This may be general, involving both large and small bowel, or partial. It is particularly important to determine whether distension involves the large intestine and all the abdominal part of it; the fullness of each flank must be noted, and by careful percussion the outline of the colon must be made out. Distension is evidence that the obstruction, though chronic, has become complete, and the extent of bowel involved in it shows the seat of the obstruction. Even when the obstruction is low down, the cæcum is the part of the colon to be distended first, and its condition should in all cases be specially noted.

2. **Accumulation of fæces.**—When the obstruction in the colon is chronic but not complete, fæcal matter may be held back above it, and be felt in the colon, particularly in the sigmoid colon above disease in the rectum, and in the cæcum. The detection of fæcal masses in the colon is important evidence of the presence of chronic obstruction.

3. **Visible and audible peristalsis,** coming on spontaneously or when the abdomen is exposed, or excited by palpation, is a proof of mechanical obstruction

rendering the peristalsis ineffective, and also causing hypertrophy and distension of the bowel above. It may be attended with loud gurgling sounds and with griping pain. It is generally easy to determine whether the peristalsis is in the small or the large bowel.

4. **Tenderness.**—It is important to notice any tenderness in the bowel, particularly in the cæcum or sigmoid colon. In these situations stercoral ulceration is liable to occur, and tenderness is the only local sign which gives warning of its presence.

5. **Tumour.**—If any tumour can be felt, its exact seat, size, fixity or mobility, and consistence must be noted.

6. The **liver** must be examined for evidence of enlargement and for hardness or irregularities of its surface, such as may be caused by secondary malignant disease. For the same reason the skin and conjunctiva and the urine will be examined for evidence of *jaundice.*

7. **The abdominal wall.**—In cancer of the intestine, as well as of the stomach, secondary growths are liable to occur at the umbilicus in the form of firm discoidal nodules, and the detection of such a lump is important in any case of obstruction as showing its nature and the occurrence of metastasis.

8. The **inguinal glands** should be examined for the same reason, and any enlargement carefully noted.

9. All the seats of **hernia** must be examined.

10. **Rectal examination.**—Having completed the examination of the abdomen, the surgeon should himself, if possible, see one or more of the stools, noting the points in them to which reference has already been made, and then he should explore the rectum. This should be done first of all with the finger properly gloved and lubricated, and then, if necessary, with the

proctoscope or sigmoidoscope. The finger will notice the resistance or flaccidity of the sphincter ani, and the smoothness and softness of the anal canal, or any induration or unevenness of its walls. The finger then explores the rectum proper, noticing its lumen, whether contracted (stricture), distended (ballooning), or enlarged by ulceration; whether empty or occupied by fæcal masses or a foreign body, a prolapsed growth, or an intussusception. The finger then feels the rectal wall, whether thickened or hardened at any part, and whether the bowel is fixed or movable, or displaced and compressed by a growth outside it. With a well-illuminated proctoscope the mucous lining of the rectum can be seen, and with a sigmoidoscope the rectum and lower pelvic colon can be explored, and changes in its mucous membrane and in its dilatability can be studied with a precision not otherwise attainable.

If the patient has vomited, the vomited matter should be examined, and in particular its odour, colour, and reaction to litmus-paper noted, to determine whether it is ordinary stomach contents, or this with the addition of bile only and green in colour, or whether it is regurgitant vomit from the small intestine, or even fæcal matter from the colon.

Lastly, the surgeon must take note of the patient's general condition, particularly of emaciation, pallor, and the signs of asthenia.

If the patient is otherwise in good health, but passes a hard motion at long intervals, the motion being dark in colour and of normal size, and the rectum is found healthy and empty, the belly not greatly distended nor containing a tumour, and particularly if the patient is an anæmic young woman, it may be considered a case of **atony of the bowel.**

If with symptoms like the above the rectum is found full of hardened fæces, or similar fæcal masses can be felt in the colon, it is usually spoken of as a case of **fæcal impaction.** The two conditions have very much in common. In fæcal impaction the patient may pass, even daily, small hard lumps of fæces, or be troubled with tenesmus and a frequent evacuation of mucus stained with fæces. This condition is often met with in elderly people.

If with the signs of chronic obstruction an elongated tumour is felt in the belly, and the patient discharges mucus with a small amount of fæcal matter from the rectum, and complains of irregular colicky pains and tenesmus, **chronic intussusception** is to be diagnosed. The end of the intussuscepted length of bowel may be felt in the rectum.

For the diagnosis of **simple** and **malignant stricture of the rectum,** *see* p. 615.

If these causes can be excluded, the surgeon must attempt to determine by the amount and character of the abdominal distension whether the obstruction is seated in the large intestine or in the small bowel. Malignant disease is much more frequent in the large than in the small bowel, while chronic peritonitis or adhesions or traction most often affect the small intestine. If a tumour can be detected through the abdominal wall it is of great value in the diagnosis. If the signs point to obstruction in the small intestine, and there is a history of previous peritonitis, or of pelvic inflammation or tumour, and the constipation is not absolute, the condition may be attributed to **chronic peritonitis,** or some similar cause, dragging upon or binding down the intestine and impeding its peristalsis. When, however, the obstruction is seated in the large intestine, and the disease has steadily and continuously progressed, whether a tumour can or cannot be felt, it is most probably due to **cancer of the colon.** The earliest symptoms may be those of indigestion and flatulence, together with some persistent alteration in the previous habit of action of the bowels, and later the signs of obstruction may be combined with mucous or bloody diarrhœa, emaciation, and progressive anæmia. Secondary deposits may be detected in the liver and elsewhere. A somewhat similar history in a stoutish person, extending over a long period, perhaps years, especially if there is present a fixed but tender and sometimes painful tumour in the region of the pelvic colon, points to **chronic diverticulitis.**

Valuable information as to the presence, position, and in some cases the cause of the obstruction is afforded by the use of bismuth and X-rays. For obstruction above the ileo-cæcal valve, a bismuth meal must be followed through the intestine. For obstruction below this point, the colon may be filled with a bismuth or barium enema, examined with a fluorescent screen, and then photographed.

Congenital intestinal obstruction.—Whenever a new-born infant does not pass the meconium within twenty-four hours, it should be carefully examined to ascertain whether there is some deformity of the lower bowel. Vomiting and abdominal distension are other symptoms calling attention to this condition. The surgeon will have to ascertain three facts: whether the anus is developed, whether the rectum is developed, and whether the rectum has formed any unnatural communication with the bladder, uterus, or vagina. By inspection of the perineum it will be at once observed whether the *anus is developed* or not. Having ascertained this point, the surgeon must try to determine whether the rectum is developed. Passing his little finger into the anus, he feels for a tense, bulging swelling filling out the pelvic cavity: this may be felt separated from the anus by a thin septum, or at a greater distance; or, on the other hand, the finger may quite fail to find any such swelling in the pelvis. If there is no anus, the surgeon feels carefully in the perineum and notices whether it bulges when the child cries or strains, or when pressure is made on the hypogastrium and iliac fossa; by such signs the distended rectum may be located. Communication of the rectum with the bladder or urethra, or with the vagina, will be shown by the escape of the meconium in the urine, or from the vulval orifice.

CHAPTER XXXIX

DIAGNOSIS OF SOME CASES OF CHRONIC INDIGESTION

Within recent years a large number of cases of chronic indigestion have been found to be due to conditions susceptible of relief or cure by surgical treatment, and it is therefore necessary that surgeons should be able to investigate such cases and to diagnose those conditions which can be dealt with surgically, and to distinguish these cases one from another. The group of cases we are now to consider is not very clearly definable, but they are generally characterized by abdominal discomfort or pain, sometimes by nausea or vomiting, belching of wind or intestinal flatulence, constipation, and a certain degree of debility. The symptoms have been of some duration when the patient comes for advice, and he often associates them in some way with the taking of food. Included in this group of cases are—

Absence of molar teeth.
Pyorrhœa.
Gastric ulcer.
Pyloric stenosis.
Hour-glass stomach.
Carcinoma of stomach.
Dilated stomach.
Duodenal ulcer.
Ileal kink.
Chronic duodenal ileus.
Chronic appendicitis.
Stenosis of colon.
Internal hernia.
Cholecystitis and cholelithiasis.
Chronic pancreatitis.
Pancreatic calculus.
Cancer of pancreas.
Enteroptosis.
Visceral adhesions.
Cæcal stasis.

To arrive at a diagnosis in these cases, the surgeon should first inquire carefully into the history of the case, then note exactly the symptoms, and finally make a thorough examination of the teeth and of the abdominal organs.

I. **The history.**—Two classes of facts in the history are of special importance: (1) the mode of onset of the symptoms; (2) their duration and progress.

1. The **onset of the symptoms** may have been spontaneous, or without recognizable cause, or it may have followed some acute illness, or operation, or pregnancy. The symptoms may have come on abruptly, or so gradually that their beginning was unperceived. An abrupt onset indicates either an infection, or some mechanical disturbance such as the displacement or kinking of a part or the movement or impaction of a stone. A sequel to an acute illness is caused by permanent damage to an organ by inflammation, or by interference with its function by adhesions. If the illness follows upon an operation, it is the result of adhesions, or it is caused by the direct effect of the operation; the disturbance of pregnancy is often followed by cholecystitis and cholelithiasis. Where the symptoms have come on without a known cause they are likely to result from an auto-infection, from some persistent violation of physiological law, or from the onset of malignant disease.

2. **Duration and progress of the symptoms.**—The *duration* of the symptoms is chiefly significant as showing the greater or lesser gravity of the functional disturbance. The history of the *progress* of the symptoms is more important. They may have been persistent and unchanged for years, indicating a very chronic and less grave condition; they may have been definitely intermittent, constituting successive

attacks of illness, indicating successive infections or exacerbations; or there may have been some recent aggravation or change in the symptoms, indicating the onset of a secondary complication such as carcinoma engrafted upon a chronic ulcer, cholecystitis secondary to appendicitis, stenosis following upon ulceration or upon the impaction of a gall-stone.

II. **Symptomatology.** 1. **Pain.** (*a*) *Its seat.*—Pain is not always felt close over the seat of its cause, although this is often the case, e.g. in gastric ulcer, cholecystitis, and appendicitis; sometimes it is referred to a surface distant from the cause, e.g. the right shoulder in gall-stones, around the umbilicus or at the epigastrium in appendicitis. Patients are often able to state definitely that the pain is wholly above the umbilicus or wholly below that point, and, still more, that it is entirely limited to the right or to the left side of the belly. Where this is so, the cause of the pain is in the first case to be sought in the stomach, gall-bladder and bile-ducts, duodenum, or transverse colon; in the second case, in the small intestine below the duodenum, the cæcum, appendix, right or left colon; in the third case, in the appendix, cæcum, ascending colon, or gall-bladder if the pain is wholly right-sided, and in the descending and sigmoid colon if wholly left-sided. Again, there are many cases where the patient says the pain is at a particular definite "spot"—the upper or lower epigastrium, the right hypochondrium just below the ninth costal cartilage, beneath the right rectus muscle just above the umbilicus, or in the region of the cæcum. When pain is limited to one of these small areas it usually indicates that the cause of the pain is immediately beneath that part of the abdominal wall.

(*b*) *Character of the pain.*—Not much importance is to be attached to such descriptions of pain as "burning," "stabbing," "cutting," "dragging," "gnawing," but a good deal of weight is to be put upon the use of the term "griping" or "labour-like," as an indication of strong but ineffective action of involuntary muscle, as in the biliary passages, stomach, or intestine. When pain is described as "shooting," the direction in which the pain is said to shoot should always be inquired into. Thus, pain shooting from the epigastrium round the right side of the body to the lower dorsal spine—sometimes also up to the right shoulder—is very characteristic of trouble in the gall-bladder or bile-passages; pain in the right iliac region, shooting up towards the umbilicus or lower epigastrium, or across to the left iliac region, is often mentioned in cases of chronic appendicitis; occasionally in this affection the pain is described as shooting down the front of the right thigh or along the fold of the groin, but not to the pubes or along the urethra. Extension of the pain from its original site to another part may be a significant point, e.g. the extension of epigastric pain through to the back may indicate the extension of a gastric ulcer through the stomach wall to the pancreas.

(c) *Onset of the pain.*—This may be gradual, sudden, or intermittent. Gradually increasing pain is felt in such cases as pyloric stenosis and gastric ulcer; sudden pain occurs in gall-stones, in appendicitis, and in internal hernia; intermittent pain in duodenal ulcer and in gastric or intestinal obstruction. The time at which pain occurs is often significant—not only the time of day, but also the relation of the pain to the taking of food and the passage of wind or motion. The pain of chronic appendicitis often comes on in the early hours of the morning or after exercise, and it is not influenced by the taking of food nor by the character of the food taken. The pain of gastric ulcer comes on at an interval after taking food, and is worse after solid than after bland fluid food. The pain of duodenal ulcer is relieved by taking food, and then comes on again two or three hours after the food; it is worse after a mixed meal than after bland fluid food. The pain of chronic cholecystitis and of cæcal stasis comes on in the later hours of the day. The pain of gastric distension is relieved by copious belching or vomiting; the pain of gastric ulcer, by the speedy vomiting of food taken; the pain of intestinal obstruction, by the free passage of flatus and fæces.

2. **Nausea and vomiting.**—Nausea is met with in cholecystitis, intestinal kinks, visceroptosis, and cæcal stasis, and is a marked symptom in some cases of gastric cancer. Vomiting is met with in gastric cancer and in some cases of gastric ulcer; copious vomiting, and vomiting of food taken a day or two before, in cases of pyloric obstruction; occasional fæcal vomiting, in cases of cancerous fistula between the stomach and colon. (For fæcal vomiting in cases of intestinal obstruction, *see* Chap. XXXVIII.) Hæmatemesis occurs in gastric ulcer and cancer and in duodenal ulcer. The association of acute spasmodic pain with belching of great volumes of wind is often seen in biliary colic.

3. **Jaundice.**—When the patient gives a history of having been yellow in colour, and reports that at the same time the motions were pale or chalky in colour and the urine very dark, it is certain that there has been obstructive jaundice, and this fact would strongly support a diagnosis of gall-stones.

4. **Stools.**—In many of these cases it is necessary to examine the stools oneself, but a history of copious

melæna, with or without sudden faintness, points usually to duodenal ulcer; a history of the passage of a little red-brown blood and mucus in the stools would rather indicate the presence of an ulcerated growth in the colon or of a chronic intussusception. A history of chronic constipation or of the constant and more or less ineffectual taking of aperients is common in many of these conditions, and is a marked symptom in visceroptosis, cæcal stasis, and visceral adhesions. Occasional attacks of diarrhœa with habitual constipation occur in ileal kink. The passage of a large-sized motion, even at long intervals, shows that there is no narrowing of the lower colon or rectum; the repeated passage of tiny fæcal pellets is often associated with the development of diverticulitis; the progressive diminution in size of the motions and increasing difficulty in getting the bowels to respond to purgatives are characteristic of a gradually increasing stenosis of the colon.

5. **Rigors.** — The occurrence of irregular rigors associated with a feeling of depression and with jaundice is very strongly indicative of a calculus in the common bile-duct.

6. **The general condition.**—Rapid wasting and increasing debility out of proportion to the other symptoms usually result from cancer. Considerable emaciation and great weakness may result from non-malignant conditions, such as cicatricial pyloric stenosis or hour-glass stomach when this condition has existed for years.

III. **Examination of the patient.** 1. **Teeth and gums.**—Notice particularly whether there are sufficient sound molar teeth to effect proper mastication, and whether pyorrhœa is present. The signs of pyorrhœa are a red line along the free edge of the gum, recession and ulceration of the gums, the welling up of pus around the neck of a tooth when the gum is pressed, and a peculiar odour of the breath. Pyorrhœa may be present on the oral side of the teeth alone, and, since in some cases it is only identified after a very careful search, the examination must not be cursory.

The absence of efficient molar teeth is a frequent cause of pain after food, and of flatulence; if this is the cause of the symptoms, they quickly disappear when the patient has proper dentures. Pyorrhœa may, in some cases, be a causative factor in gastric and duodenal ulcers.

2. **General form of the abdomen.**—The abdomen may be generally distended, flaccid or scaphoid, or local distension of the stomach, cæcum, or colon may be apparent. Through the thin abdominal wall a tumour of stomach, of pancreas, of liver, of gall-bladder, or of cæcum may be evident. Peristaltic waves of intestinal contraction may be visible; unless there be such thinness of the abdominal wall that peristalsis of normal intestine is visible, they indicate hypertrophy of the intestinal musculature, and are a sign of organic intestinal obstruction, and therefore of great importance in diagnosis; if they are not excited by the mere exposure of the abdomen, gentle pressure of the hand is often sufficient to bring them on. They are frequently accompanied by gurgling sounds (borborygmi) and by griping pain. With the patient upright, a flattening of the epigastrium with a bulging of the hypogastric and iliac regions betokens a general enteroptosis.

3. **Respiratory mobility of the abdomen.**—Get the patient to take two or three slow, full breaths, and notice whether the abdominal wall rises and falls fully and equally as it should, or whether its movement is less free than normal, or limited in area, and whether any viscus or tumour can be seen to

move up and down beneath it. Full and equable mobility indicates the absence of muscular rigidity, and of marked tenderness of the abdominal viscera. Local immobility is a useful indication of the presence and position of a tender viscus such as an ulcerated duodenum or an inflamed appendix. A tumour that is seen to move under the abdominal wall during respiration is certainly connected with one of the viscera adjacent to the diaphragm—stomach, liver, gall-bladder, or spleen—and is free from serious adhesions.

4. **Muscular rigidity and tenderness.**—Place the hand flat upon the abdomen, then gently flex the fingers, and notice very carefully any lessening of the flaccidity of the wall. In some cases the local rigidity is very slight yet definite, and it will be missed unless sought for with care. The flaccidity of corresponding areas of the two sides, particularly of the two iliac regions, and of the upper part of each rectus muscle, should be very carefully compared. Rigidity is an indication of hypersensitiveness of the subjacent viscus, and is an important sign of appendicitis in one situation, and of duodenal ulcer in the other. Then examine with equal care for *local tenderness*—first with gentle pressure of the flat hand; if none is elicited, firmer pressure may be made, and then a single finger-tip should be gently but steadily pressed backwards. This examination should be made systematically so as not to miss out any portion of the belly; it is especially important at the epigastrium, in the right iliac region, over the upper part of the right rectus, and below and beneath the right costal arch, particularly at the outer edge of the rectus muscle. To examine for tenderness of the gall-bladder, when there is no gall-bladder tumour to be felt, the finger-tips of the

right hand should be pressed up just below the ninth and tenth costal cartilages, and the patient should then take a full inspiration; this will bring the gall-bladder down against the fingers, and if it is tender will occasion pain. Tenderness at the epigastrium is met with in gastric ulcer, especially along the lesser curvature, in the anterior wall, and near the pylorus. Tenderness to pressure with a finger-tip at a spot midway between the xiphoid cartilage and the navel is never absent when a gall-stone is impacted in the cystic or in the common bile-duct. Tenderness just above and a little to the right of the navel is a sign of duodenal ulcer. Tenderness about one-third of the distance from the right anterior iliac spine to the navel, and when the hand is felt to roll over the lower edge of the cæcum, is a sign of appendicitis; when this pressure causes pain also referred to a point just above the navel, it is still more indicative of chronic appendicitis. Tenderness may be found over any abdominal tumour.

5. **Tumours and their characters.**—The reader is referred for details to Chap. XXXVI. Attention in the cases we are here considering should be especially directed to determining the exact seat of any tumour, its mobility within the abdomen, its dullness or resonance on percussion, and its constancy. As to the last point, the distension of the stomach or of part of the bowel may be intermittent, and the tumour it causes may be sometimes present, sometimes absent, or varying in size. Again, a distended and obstructed stomach or coil of bowel may be only recognizable when made tense by the contraction of its muscular coat, and manipulation of the part may, by causing this contraction, make the tumour become gradually palpable. When this is recognized, its significance is great in the diag-

nosis of pyloric obstruction, intestinal obstruction, and chronic intussusception. In other cases, during massage of a lump it may be felt to melt away gradually under the hand by the subsidence of muscular spasm.

6. **Position, size, and mobility of the abdominal viscera.**—By percussion define the position and size of the stomach and liver, feel the lower edge of the liver and, if possible, the gall-bladder, and determine the degree of mobility of each kidney. By percussion the gaseous distension of the intestine can be determined; it is especially important to notice any relative distension of the higher colon as compared with the lower part, as this is a sign of obstruction to the free passage of its contents.

In particular the cæcum may be felt distended to form a soft mass with an ill-defined outline, manipulation of which produces well-marked gurgling and some discomfort.

7. **Examination of vomited matter.**—The vomiting of a very large quantity of material is evidence of distension of the stomach, which is usually dependent upon chronic pyloric obstruction. The presence in the vomit of portions of food taken many hours or even a day or two before is evidence of delay in the passage of food out of the stomach; and a yeast-like appearance and odour of the vomit, and the detection of sarcinæ ventriculi under the microscope, also show that there is obstruction to the passage of food from the stomach into the duodenum. The frequent presence of blood in small quantity is a common sign of gastric cancer, while occasional large hæmorrhage is met with in gastric or duodenal ulcer, in cirrhosis of the liver, and in aneurysm rupturing into the stomach or duodenum. The detection of fæcal matter in vomit, in the

absence of signs of complete intestinal obstruction (*see* p. 550), is evidence of gastro-colic fistula due to ulceration, or of cancer involving the stomach and transverse colon.

8. **Examination with X-rays** after a bismuth or barium meal is proving in skilled hands of increasing value in this class of case. By this means the position, size, and shape of the stomach, the position, mobility, and size of the pylorus, the vigour and efficiency of the muscular contraction of the stomach, and the length of time the bismuth remains in the stomach can be shown. Next, the outline of the duodenum can be studied, and the very rapid and complete passage of the bismuth through the small intestine, or its arrest at the lower end of the ileum, can be seen; in the latter case definite displacement, kinking, or stenosis of the lowest part of the ileum may be shown. The size, position, and rate of passage of the bismuth through the various parts of the colon can also be studied in the later skiagrams. In diseased conditions of the colon examination with X-rays after the administration of a barium enema is also of great value.

9. **Fractional gastric analysis.**—This elaboration of the simple test-meal, if methodically carried out, is capable of yielding useful information. Removal of the fasting content of the stomach may show delay in emptying, and the samples removed at intervals after the taking of the meal allow of estimation of the rate of secretion and the character of the gastric juice, as well as of any abnormal constituents.

10. **Examination of fæces and urine.**—Melæna is evidence of extensive hæmorrhage into the alimentary canal high up, and is seen in gastric and especially in duodenal ulcer; it is, however, only an occa-

sional event. But the presence of a small quantity of blood in the motion, such as can only be recognized by chemical tests, e.g. the guaiacum and ozonic ether test, or, better, by the benzidine reaction (occult blood, as it is called), is an important sign of the frequent slight oozing of blood into the bowel that occurs in duodenal ulcer and in cancer.

The size and shape of the stools is of importance in the diagnosis of many conditions (*see* p. 566). In the affections we are now considering the frequent passage of small firm pellets like sheep-droppings should be noted, as it suggests the presence of chronic diverticulitis. Large, pale, porridge-like motions indicate a failure of intestinal digestion, usually due to absence of sufficient pancreatic juice, from chronic pancreatitis, from obstruction of Wirsung's duct by a calculus or by cancer of the head of the pancreas. In such cases a microscopical examination of the fæces reveals very imperfect digestion of muscle-fibre. A greatly increased diastase index in the urine is further evidence of serious interference with the digestive function of the pancreas.

Having considered the history of the case, the symptoms presented, and the results of these various methods of examination, a diagnosis may be arrived at. It is necessary to remember that more than one pathological condition may be present and sharing in the production of the symptoms, and there are cases in which the diagnosis is only cleared up by a surgical exploration or by observing the effects of surgical treatment.

1. **Absence of molar teeth.**—A sense of fullness after a meal, which may amount to pain, flatulence, and chronic constipation, associated with debility, anæmia, and poor nutrition, may be due

to the want of molar teeth. If when this want is supplied the symptoms disappear, the diagnosis is established.

2. **Pyorrhœa.**—We have already indicated how the presence of pyorrhœa may be determined. Its recognition is important because it may directly cause the symptoms of which the patient is complaining—pain after food, vomiting, constipation with anæmia, wasting and debility—and also because grave abdominal lesions, such as gastric and duodenal ulcer, cholecystitis, and appendicitis, may be due to secondary infection from the gums. Wherever found to be present, it should be vigorously dealt with and cured, first to determine what part it has been taking in directly causing the symptoms complained of, and also to remove a possible source of infection of other parts of the digestive tract, and to allow of the "spontaneous" subsidence of secondary lesions.

In what follows it will be assumed that the "chronic indigestion" in question is not directly due either to absence of molar teeth or to pyorrhœa.

3. **Gastric ulcer.**—When the patient, most often a middle-aged man, gives a history of epigastric pain, occurring in attacks, with intervals, perhaps of some weeks' duration, of complete freedom, the pain starting quickly after a meal, or at an interval up to one and a half hours, passing off before the next meal, and relieved by vomiting or the taking of alkalis, a gastric ulcer is to be suspected. The history may extend over some years, and there may be lengthening of the attacks with increased severity of the pain and its extension through to the back, but little loss of appetite or of weight. In the absence of pyloric stenosis, fractional analysis shows in most cases a slight

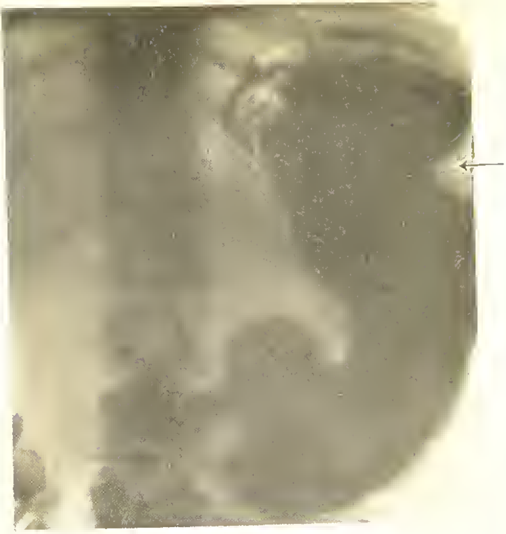


Fig. 1.—Gastric ulcer.

Arrow indicates incisura.

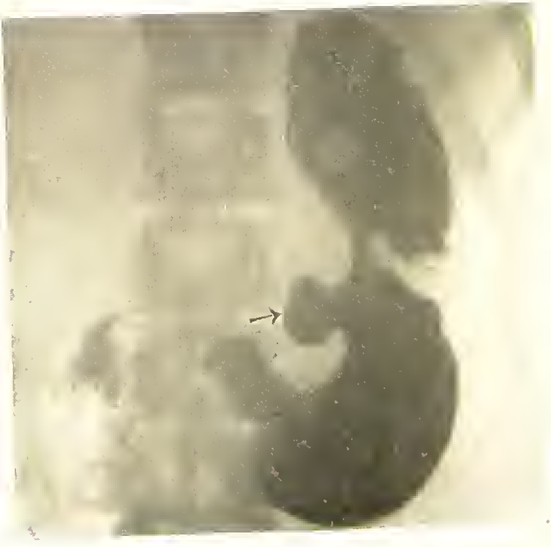


Fig. 2.—Gastric ulcer.

Arrow indicates crater of ulcer filled with barium.

PLATE XV.

increase in acidity only. But the greatest help is afforded by the X-rays, the crater of the ulcer filled with the barium appearing as an excrescence on the lesser curvature, or a persistent notch in the outline of the greater curvature, indicating a spasm of the stomach-wall at the level of the ulcer. (Plate XV.)

Complications such as stenosis of the pylorus, hourglass contraction of the stomach, adhesion of the stomach to the pancreas, and the supervention of carcinoma may render both the history and the other data atypical of ulcer. No characteristic signs are to be found on physical examination of the abdomen, and chief reliance in diagnosis must be placed on the history, together with confirmatory, or the absence of conflicting, analysis and X-ray findings.

4. **Pyloric stenosis.**—Where the pain after food gradually culminates in severe discomfort, which is relieved by the vomiting, perhaps at intervals of a day or two, of a large quantity of material, and where a bismuth meal is found to be still in the stomach several hours after its ingestion, or is seen to pass through the pylorus in a very narrow stream, pyloric stenosis is to be diagnosed. The detection in the vomit of food taken two or three days before, or of great numbers of putrefactive bacteria, of yeast fungi, and of sarcinæ, as well as of butyric and other acids of fermentation, will corroborate this diagnosis.

The cause of the stenosis, whether cicatrization of an ulcer near the pylorus, or a carcinoma in this region, will be revealed in part by the previous history of the case, i.e. one typical of gastric or duodenal ulcer, and in part by the presence or absence of a definite abdominal tumour, and blood in the vomit.

5. **Hour-glass stomach.**—Where there is a long history of pain after food and occasional vomiting, and a bismuth meal is seen to lie in the left fundus of the stomach and to pass through a narrow passage to the pyloric antrum, the fact of a so-called hour-glass contraction of the stômach is established. In view of the demonstration the bismuth meal affords it is unnecessary to recount more troublesome and less definite methods of diagnosis. (Plate XVI., Fig. 1.)

6. **Cancer of the stomach.**—When a patient at or past middle life complains of pain in the epigastrium soon after taking food, with more or less frequent vomiting and rapidly progressing debility and wasting, and on examination a firm, slightly tender lump is felt in the region of the stomach, the case is one of cancer of the stomach. In many cases there is a previous history of chronic ulcer of the stomach. And if, with such a history, there has been a recent increase in the pain with anæmia and loss of weight, and gastric analysis reveals foul-smelling, blood-stained fasting stomach contents, the diagnosis can be made in the absence of a palpable abdominal tumour. The skiagram after ingestion of a bismuth meal affords most valuable evidence, especially in those cases where no lump can be felt and the history and signs are equivocal. The typical appearance is a "defect" in the outline of the shadow, usually at the pyloric end, causing a distortion of the normal shape with an irregular border. The bismuth is either delayed in the stomach owing to pyloric stenosis, or it leaves the stomach with abnormal rapidity if the growth interferes with the action of the pyloric sphincter. (Plate XVI., Fig. 2.)

7. **Dilated stomach.**—When, together with

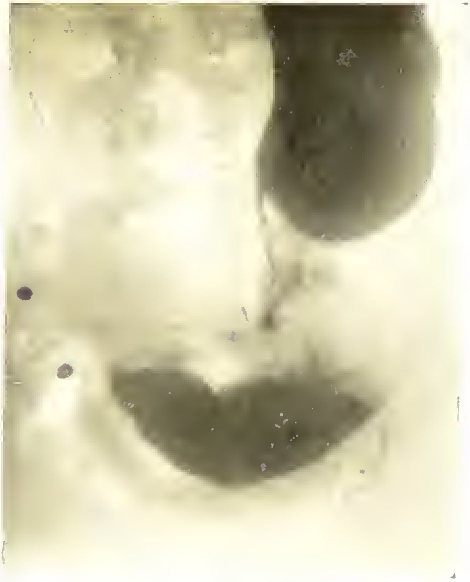


Fig. 1.—Hour-glass stomach.

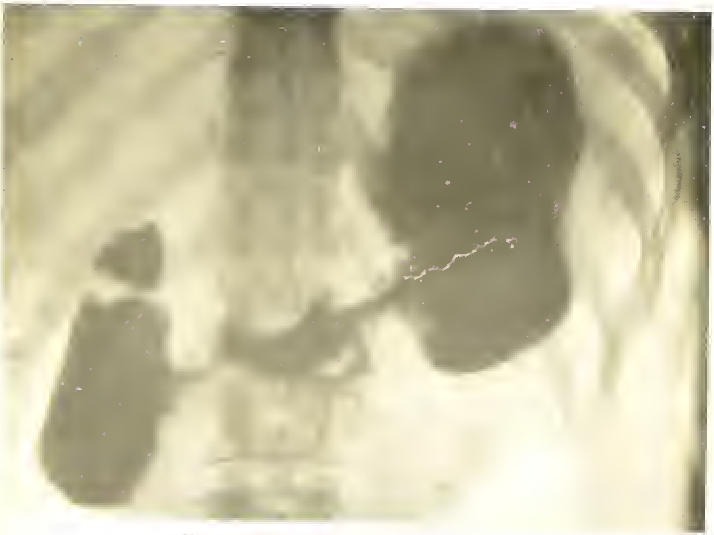


Fig. 2.—Carcinoma of the stomach.

PLATE XVI.

symptoms of chronic indigestion, discomfort and fullness after food, much belching of wind, occasional copious vomiting, and constipation, the area of stomach resonance is found to be increased and lowered, and a skiagram after a bismuth meal shows the stomach to be enlarged and abnormally low, but without any narrowing of the pylorus, the diagnosis of dilatation and ptosis of the stomach should be made.

8. **Duodenal ulcer.**—When a patient complains of intermittent or recurring attacks of pain coming on two to three hours after taking food and lasting until the next meal, and often occurring nightly at the same hour, the pain being relieved by taking food or alkalis, it is almost certain that the attacks are due to a duodenal ulcer. And when in addition to these symptoms there are found some rigidity of the upper part of the right rectus muscle and tenderness above and to the right of the navel, or there has been a sudden melæna with or without hæmatemesis, and the stools are found to contain "occult blood," this diagnosis is certain. Gastric analysis shows a high acid content in the resting juice, and a quicker, higher and more sustained output of HCl after the meal. A bismuth skiagram may show some deformity of the duodenum, and increased rapidity of passage of the bismuth through the duodenum, or even through the whole of the small intestine. Duodenal ulcer is more common in men than in women.

9. **Ileal kink.**—When with symptoms of pain or discomfort in the lower abdomen a skiagram shows delay in the passage of the bismuth into the cæcum, an ileal kink is to be suspected; and if a loop of the ileum can be seen to remain filled with the bismuth after the onward passage of the greater part, the diagnosis is confirmed.

10. **Chronic duodenal ileus.**—A history of long-continued abdominal discomfort, relieved by lying down, especially in the prone position, culminating in periodic "bilious attacks" with severe vomiting, which afford temporary complete relief, suggests chronic duodenal ileus due to dragging on the root of the mesentery. This suspicion is strengthened if the patient is a thin young woman, with signs of general visceroptosis. The diagnosis is confirmed by the X-rays showing distension of the proximal two-thirds of the duodenum with delay, and by gastric analysis—in the absence of a previous gastro-enterostomy—revealing bile in the resting juice and in all subsequent specimens. But in many cases both X-ray examination and gastric analysis reveal no abnormalities.

11. **Chronic appendicitis.**—When the patient complains of pain coming on in definite attacks, independently of taking food, and the pain is referred chiefly to the lower part of the right side of the abdomen, though it may be felt also at the lower epigastrium or in the left iliac region, and there is found to be slight rigidity of the lower part of the right rectus muscle, with tenderness to pressure at or near McBurney's point, or on rolling the lower end of the cæcum under the fingers, there is chronic appendicitis. The pain not seldom comes on during the night, or is present on waking; it may be frequent, or only felt at long and irregular intervals; it is not caused or relieved by taking food, is usually made worse by exercise, and is often attended with nausea.

In a number of cases the symptoms would suggest a gastric or duodenal ulcer, but the absence of confirmatory evidence of these conditions and the detection on careful examination of some local tenderness, make a correct diagnosis possible.

12. **Stenosis of the colon.**—Irregular colicky pains referred especially to the umbilical region, with borborygmi, constipation, and gradually increasing fullness of the abdomen, suggest obstruction in the colon, and if a coil or coils of intestine become visible and palpable during these colicky pains the existence of obstruction is assured. If now one part of the colon is found to be full or distended, and the colon beyond is always found empty, or if a skiagram shows the definite arrest of a bismuth meal or enema at a particular part of the colon, the seat of the stenosis of the colon is determined.

13. **Internal hernia** is very rarely diagnosed unless it is strangulated. But if a patient has had recurrent attacks of sudden pain referred to the umbilical region, with nausea, and possibly some vomiting, and these symptoms have suddenly passed away after abdominal massage or some change of position, and careful examination fails to find any other explanation of the symptoms, the existence of an internal hernia is to be suspected. Should the patient have undergone an intraperitoneal operation at some time previous to the onset of the symptoms, this diagnosis becomes more probable.

14. **Cholecystitis and cholelithiasis.**—A history of long-continued daily discomfort at the epigastrium, coming on immediately after food, worse after a heavy meal, accompanied by a sense of fullness, and in part relieved by belching of wind, but not by lying down, strongly suggests the presence of cholecystitis with gall-stones. The history may date back to typhoid fever, influenza, or in women, in whom the disease is more common, to a pregnancy. If with such a history there is added complaint of more recent attacks of sudden spasmodic pain, especially if they come on late in the

day or in the early hours of the night, felt at the upper epigastrium and passing round the right side to the back, cramp-like or constrictive in character and associated with nausea, belching of wind, and sometimes with vomiting, while on examination the patient is found to be tender midway between the xiphoid cartilage and the navel, and just below the ninth and tenth right costal cartilages, this diagnosis is confirmed. If the gall-bladder is found to be distended, there is impaction of a stone in the cystic duct or in the ampulla of the gall-bladder. If after attacks like the above the patient has recurring attacks of jaundice, with pain and tenderness at the mid-epigastric point, and with rigors, and the gall-bladder is found not to be enlarged, there is a gall-stone in the common duct. If there is sudden complete jaundice with a small gall-bladder, and tenderness on deep pressure at the mid-epigastric point, there is a gall-stone impacted in the lower end of the common duct.

15. **Chronic pancreatitis.**—If the patient complains of discomfort about the upper and central parts of the abdomen, a sense of fullness after food, flatulence—perhaps nausea—and the passage of two or more large, pale, porridge-like motions a day, and on examination these stools are found to contain a great excess of fat and much undigested muscle-fibre, and the urine contains a great excess of diastase, there is evidently pancreatic insufficiency. If there is no lump to be felt in the pancreas, and the gall-bladder is not greatly enlarged, and a skiagram does not show any shadow in the region of the pancreas, a diagnosis of chronic pancreatitis is to be made. A previous history pointing to gall-stones, and the long duration of the symptoms, confirm this diagnosis. There may be some sugar in the

urine. X-rays reveal no abnormality of the stomach or duodenum, and gastric analysis yields a normal picture. Some cases of chronic pancreatitis so closely resemble gastric ulcer in their symptoms that the negative information afforded by these means is of great value.

16. **Pancreatic calculus.**—If with symptoms of pancreatic insufficiency the skiagram shows irregular dark shadows in the position of Wirsung's duct, the diagnosis of pancreatic calculi may be made. If there is complete jaundice with a greatly distended gall-bladder, these symptoms are due to a calculus impacted at the ampulla of Vater.

17. **Cancer of pancreas.**—If with symptoms of pancreatic insufficiency there are found enlargement of the gall-bladder, complete jaundice, and a lump above and to the right of the navel, firm, uneven, fixed posteriorly and steadily enlarging, the patient is suffering from cancer of the head of the pancreas compressing the common duct. Pancreatic insufficiency with rapid wasting, but without jaundice or enlargement of the gall-bladder, and with a lump felt a little above the navel, is probably due to cancer of the body of the pancreas.

18. **Enteroptosis.**—When there is flattening of the epigastrium with prominence of the abdomen below the navel, the liver dullness is lower than normal, one or both kidneys are felt well below the ribs in expiration as well as inspiration, and a bismuth skiagram shows the stomach to be too low, the small intestine in the true pelvis, and the transverse colon well below the navel, there is general enteroptosis. The indigestion in these cases is usually of the nature of general abdominal discomfort after food, persisting day after day, but relieved, at least in part, by lying down. The

patients are spare subjects, but there is not continuous loss of weight.

19. **Visceral adhesions.**—It is impossible to state exactly what symptoms warrant the diagnosis of visceral adhesions; the symptoms they cause vary with the part affected, the number and density of the adhesions, the extent to which they interfere with the function of the organs, and also with unexplained conditions. In two closely similar cases there may be definite symptoms in one and not in the other.

Speaking generally, the diagnosis is usually to be made when the patient has previously had an intraperitoneal operation or inflammation, and at an interval afterwards pain has come on, irregular in its onset, unconnected with the taking of food, and a careful examination fails to afford evidence of other organic disease. The pain is variously described; it may be affected by flatulent distension, constipation, or the action of the bowels. On palpating the abdomen, pressure may cause pain at a distance, as if from dragging, or pressure in one direction only may cause pain, i.e. when the adhesions are stretched. The pain is usually definitely limited to one restricted area. X-rays may show definite delay or distortion of the barium shadow at some point in the intestine.

20. **Cæcal stasis.**—A history of discomfort on the right side of the abdomen, varying from day to day but usually worse in the afternoon, and accompanied by slight and diffuse tenderness in the right iliac fossa, with gurgling on pressure over a palpable cæcum, strongly suggests cæcal stasis. Delay in the first part of the colon, revealed by barium and X-ray examination confirms the diagnosis.

CHAPTER XL

DIAGNOSIS OF THE MORE IMPORTANT SEQUELÆ OF ABDOMINAL OPERATIONS

Immediately after an abdominal operation there may be a certain amount of shock, shown by increased frequency and lessened tension of the pulse, shallow respiration, and coldness of the extremities. This should quickly pass off, the pulse regain its tension and become slower, the respiration become regular, quiet, and normal in depth, and the feet, hands, and face warmer. The unconsciousness of anæsthesia should pass into normal sleep, from which the patient should awaken and complain only of a little headache, slight abdominal pain, thirst, and nausea, with, perhaps, one or two acts of vomiting due to the anæsthetic.

Next day and subsequently the headache, nausea, vomiting, and thirst should have all passed away, there should be nothing more than trifling local pain, the patient should be able to take and to enjoy food, should not be restless or sleepless, and the pulse, temperature, and respirations should be normal, micturition should be performed naturally, and flatus should be passed from time to time. There should be neither abdominal distension nor rigidity of the abdominal wall, and the respiratory movement should be abdominal as well as thoracic. The wound, including the suture tracks, should heal by first intention without swelling, redness, or more than the least local tenderness, and should leave a linear painless and firm scar. The abdominal wall should recover its full freedom and power of muscular contraction. The bowels should act naturally, or at any rate respond easily to a laxative. The patient should recover without any abdominal disability or pain and with unimpaired nerve-control.

From this ideal progress there are many departures of all grades of severity. Some of these are common to all operations, such as immediate or delayed chloroform sickness (acidosis), retention of urine, and traumatic neurasthenia. But there are certain sequelæ of abdominal operations of which the diagnosis may be discussed with advantage, such as—

- Severe shock.
- Internal hæmorrhage.
- Vomiting, postanæsthetic.
- Vomiting from acidosis.
- Vomiting from acute dilatation of stomach.
- Vomiting from peritonitis.
- Vomiting from intestinal obstruction.
- Massive collapse of lung.
- Intestinal paresis.
- Peritonitis.
- Intra-abdominal abscess.
- Portal pyæmia.
- Thrombosis.
- Pulmonary embolism.

The diagnosis of shock is given in Chap. IV., and of internal hæmorrhage in Chap. XIII.

Vomiting is a symptom of many postoperative complications, and it is very important to distinguish between them. If the vomiting occurs quite shortly after the operation, is attended with much nausea, is excited by taking food, and the vomit smells of the anæsthetic that had been given and consists of normal gastric contents only, it is *postanæsthetic vomiting*, and usually soon disappears under treatment. But if the vomiting is frequent, occurs independently of taking food, and the patient's breath smells of acetone and the urine is found to contain acetone, the case is one of *acidosis.* This condition is most often met with in children, particularly after a second administration of chloroform, but owing to the greatly lessened use of this anæsthetic is now of rare occurrence, the patients become very collapsed, with sunken eyes and cheeks, and often die. If the vomiting is in very large amounts of dark-brown fluid, and on examining the abdomen the stomach is found to be enlarged and to extend low down into the belly, the condition is known as *acute dilatation of the stomach*; it is attended with collapse and is very often fatal. If the vomiting is in small quantities but frequently repeated, is unattended with nausea, and is a gentle regurgitation of fluid into the mouth, and the vomited matter becomes brown and then darker, even black in colour, it is the vomiting of *peritonitis.* If the vomiting continues in spite of treatment, and independently of taking food, and the vomit soon loses its acidity, becomes light-brown in colour like pea-soup, and intestinal in odour, while the urine is found to contain much indican, the case is one of *intestinal obstruction.* If these symptoms have developed immediately after the operation, they are due to failure to relieve obstruction, as, for example, in imperfect reduction of a strangulated hernia, or in overlooking a second internal strangulation or stenosis when relieving a first. But if the symptoms come on at an interval of days or weeks from an operation, they are due to an internal strangulation, kinking, or volvulus, or to obstruction developing quite independently of the operation.

Massive collapse of lung.—When the patient complains of shortness of breath, and the respirations are hurried and the mucous membranes and nails more or less cyanosed, and on examining the chest it is found that one side is more or less motionless, that the percussion note over that base is impaired, and the respiratory murmur weak, tubular in character, or absent, and that the heart's apex-beat is displaced towards that side, the condition is that described by Pasteur as *massive collapse of lung.* It may be found after any abdominal operation, even so slight a one as the radical cure of an inguinal hernia, and it may come on in otherwise quite healthy and robust patients. If it affects both lungs, and both sides of the chest are found motionless except at the upper part, with slight dullness and absence of breath-sounds over both lower lobes, the condition is one of great gravity ; in such a case the heart's apex-beat is not displaced. In massive collapse the temperature is raised and the pulse-rate is increased. This complication is observed within two or three days of an operation.

Abdominal distension is another postoperative symptom of considerable importance. Where it is unaccompanied by vomiting, fever, and increased frequency of pulse, it is due merely to *intestinal paresis* caused by considerable exposure or handling of the bowel at the operation, or by distension and congestion of the bowel before the operation, sometimes aggravated by old age of the patient or long-standing chronic constipation. Its relief by vigorous appropriate treatment confirms the diagnosis. When the abdominal distension is associated with vomiting (*see* p. 585), restlessness, increased frequency of pulse and respiration, a fall in blood-pressure, and slight cyanosis, the condition is due to *peritonitis.* There may or may not be pyrexia, and pain ; the distended colon responds with great difficulty, if at all, to purgatives and stimulating enemata.

Intra-abdominal abscess.—When at an interval of days (or longer) after an operation the patient complains of localized pain in the belly, and it is found that there is limitation of abdominal movement with more or less local rigidity of the abdominal wall and tenderness on pressure, and a swelling is felt, and at the same time the temperature has been raised for several days at least, with an evening rise and a morning partial fall, and a blood-count gives well-marked leucocytosis, there is an intra-abdominal abscess. The pulse-rate is rapid, there may be sweating and a rigor or rigors. Of these intra-abdominal abscesses there are several varieties, which are to be distinguished according to their position. If the patient has a frequent desire to defæcate and passes large amounts of clear mucus (proctorrhœa), the abscess will be found **in the pelvis,** pressing upon and about to burst into the rectum, and the finger in the rectum will feel the swelling, and will probably enable the surgeon to recognize that it is a fluid swelling by its globular outline and by its yielding under the finger.

If the swelling is found close above the pubes, possibly also extending into the pelvis, and the patient has great frequency of micturition with much pain and strangury, and the urine is mixed with bright blood and mucus or pus, the abscess is close to, and threatening to burst into, the **bladder.**

Where there are signs of intra-abdominal suppuration and the lower half of the abdomen is neither rigid, immovable, nor tender, and no swelling can be detected below the level of the umbilicus or in the pelvis, a very careful examination must be made of the upper abdomen for **subphrenic abscess.** In this condition there may be very little, if any, abdominal pain, but in most cases there is transient or persistent pain in the region of the shoulder. The exact seat of this pain, and of any local hyperæsthesia which accompanies it, must be carefully noted; for it has been found that pain behind the shoulder over the scapula indicates involvement of the posterior part of the diaphragm on that side, and pain on the top of the shoulder, more central inflammation, while pain over the clavicle indicates inflammation of the front half of the diaphragm. When the signs given below do not make the situation of the abscess clear, this fact of the localization of shoulder pain may determine the situation of an exploratory operation. The special points to determine are: (1) the presence of abnormal dullness, especially above the usual level, as either dome of the diaphragm may be pushed up by pus beneath it; (2) the existence of a tympanitic area which shifts with the patient's change of position, due to gas in the abscess; (3) displacement of the liver downwards; (4) swelling; (5) immobility of the part in respiration; (6) raising of the heart's apex-beat. There may be dullness in one or other side of the chest from consolidation of the base of the lung or from effusion into the pleura. A skiagram is often very useful in showing a collection of pus between the diaphragm and the liver. In many cases the presence of pus is demonstrated by exploratory puncture.

Six varieties of subphrenic abscess have been described. and can be more or less certainly diagnosed.

If the swelling is at the epigastrium to the left of the middle line and above the level of the umbilicus, it is a *left anterior subphrenic abscess*. There is usually a history of gastric ulcer, the heart's apex is pushed up, and there is a movable area of tympanites over the front of the swelling. If with signs of intra-abdominal abscess there is pain in the right hypochondrium and the right dome of the diaphragm is raised and the liver is not displaced downwards, there is probably a *right anterior subphrenic abscess.* A shifting area of tympanites confirms this diagnosis and indicates that the abscess is secondary to gastric or duodenal ulcer.

But if with these signs there is marked displacement of the liver downwards, it shows that the abscess is a *right extraperitoneal subphrenic abscess* between the layers of the right coronary ligament. If the abscess is found beneath and below the lowest ribs on the right side, filling out the loin, it is a *right posterior subphrenic abscess.* If the abscess is similarly placed on the left side behind the stomach, it is a *left posterior subphrenic abscess.* And if with signs of consolidation of the base of the left lung an abscess is detected pointing in the loin, it is probably a *left extraperitoneal subphrenic abscess* between the layers of the left coronary ligament. These last two abscesses are very difficult to diagnose.

Portal pyæmia.—If the patient has a succession of rigors at irregular intervals, with raised and irregular temperature, and becomes more or less jaundiced, it is a case of portal pyæmia due to infection from some part of the area whose veins enter the vena porta. The liver is usually a little enlarged, easily felt below the ribs, and is slightly tender.

Thrombosis.—When the patient has an abrupt rise of temperature and concurrently complains of a dull pain in one groin—more often the left—extending down the thigh in the line of the vessels, and on examination the hollow of the groin is found to be a little filled up, and tender on gentle pressure to the inner side of the common femoral artery, there is a *femoral thrombosis.* Slight œdema about the ankle of the same side only, spreading in the course of a day or two up the limb, confirms the diagnosis.

Pulmonary embolism.—When, with or without previous evidence of venous thrombosis, the patient is suddenly seized with a sharp pain in the chest, acute dyspnœa, and coughs up blood, or blood and mucus, there is a pulmonary embolism. A large proportion of such cases end fatally within a few minutes. In the non-fatal cases the severity of the distress is in proportion to the size of the vessel occluded, and the subsequent course depends upon the infectivity of the clot. If the infarct is large, an area of dullness with weak breath-sounds rapidly develops, and, if it is infected, an abscess of the lung or gangrene is likely to follow.

CHAPTER XLI

DIAGNOSIS OF ABDOMINAL HERNIA

The diagnosis of a hernia consists (1) in recognizing that a given swelling is a hernia; in determining (2) the exact situation and anatomical variety of the hernia, (3) the nature of the contents of the hernia, and (4) its pathological condition.

The phenomena of hernia vary so much in different cases that there are only three features common to it in all conditions. These are (*a*) the presence of a tumour; (*b*) its connexion with the abdominal cavity; and (*c*) the sudden or gradual appearance of the tumour as a protrusion from the belly. In the great majority of cases we find the tumour at one or other of the favourite seats of hernia, and learn that it is or has formerly been reducible, with reappearance of the tumour under effort or strain, and we are able by the characteristic feel of the tumour, by tympanitic percussion, or by a gurgle in it, to demonstrate that its contents are one or other of the abdominal viscera, and, by an impulse on coughing, that it communicates with the abdominal cavity.

Anatomical varieties of hernia.—All scrotal and labial hernias descending from the groin are *inguinal*. A hernia occupying the fold of the groin may be either inguinal or femoral. Abduct the thigh and make the adductor longus tense, and then run the finger up along it, to the pubic spine; if, now, this point of bone is internal to the hernia it is a *femoral hernia;* if external, an *inguinal hernia.* In the case of a man, the surgeon should pass his forefinger from the bottom of the scrotum up along the cord to the external abdominal ring, when he will be able to feel whether the tumour protrudes through that opening or not. If the hernia is felt distinctly below Poupart's ligament (ligamentum inguinale) it is *femoral.*

A small hernia lying in the inguinal canal is called a *bubonocele.* A hernia at or close to the umbilicus is known as an *umbilical* hernia: when congenital the protrusion is through the umbilical orifice; in later life the "ring" is often an aperture in the linea alba close to this. A hernia protruding at any other part of the abdominal wall is known as *ventral;* this occurs at the seat of old cicatrices or muscular ruptures, and differs from other herniæ in having no "neck" to the sac.

Should a hernial tumour be found below Poupart's ligament (ligamentum inguinale), to the inner side of the femoral vessels and deep among the adductor muscles, it is an *obturator* hernia. It is rare for this variety of hernia to form a distinct tumour; there may be nothing but a slight sense of resistance deep down beneath the pectineus muscle, with tenderness on pressure at this spot, and pain along the course of the obturator nerve. A careful examination of the inner aspect of the obturator ring should be made from the rectum or vagina. Other rare forms of hernia are *vaginal, lumbar, pudendal, perineal, ischiatic,* and *femoral hernia external to the femoral vessels.*

Varieties of inguinal hernia.—The following varieties of inguinal hernia are met with:—

1. **Congenital hernia,** or hernia into the tunica vaginalis, characterized by the sudden appearance of a hernia which completely envelops the testicle.

2. **Funicular hernia** is a hernia into the unobliterated upper portion of the funicular process. The tumour appears suddenly and may reach to the top of the testicle but does not surround it. Even when the hernia is large the testicle can be felt below it and quite separate from it.

3. **Acquired hernia,** recognized by its appearance first in the groin, then spreading slowly along the cord into the scrotum, where it lies in front of the testicle but does not envelop it. This form may be (*a*) *indirect* or *oblique* if the hernia protrudes through the internal abdominal ring, recognized by its appearance first in the inguinal canal and by observing that after reduction the protrusion on coughing is felt by a finger invaginated into the canal, at the outer end of the canal; (*b*) *direct* if the hernia protrudes through one of the inguinal fossæ on either side of the obliterated hypogastric artery—in this case the hernia is felt to protrude immediately behind the external abdominal ring. Either of these is called "incomplete" if it does not extend through the external ring, and "complete" when it does.

An oblique hernia, when old and large, drags inwards the internal ring and comes to resemble clinically a direct hernia. Congenital and funicular hernias are always oblique.

The name *interstitial* is given to cases of inguinal hernia in which the sac spreads out either beneath or more rarely, superficial to the aponeurosis of the external oblique, forming a tumour above the fold of the groin extending externally to the site of the internal ring. This condition is almost always associated with an undescended testicle on the same side.

The terms "congenital" and "acquired" are misleading, as it is known that in the great majority of so-called acquired hernias the sac is preformed.

Contents of a hernia.—If a hernia is tympanitic on percussion, smooth, rounded, and elastic, has a distinct impulse on coughing, or yields a gurgle on manipulation, it is an *enterocele*, i.e. contains intestine. When it is dull on percussion, firm, lobulated, and does not gurgle, and has only a slight impulse on coughing, it is an *epiplocele*, i.e. contains omentum. If in places it is tympanitic on percussion and soft and gurgling, but in others firm and lobulated, it is an *entero-epiplocele*. When a hernia fluctuates throughout, there is a *hydrocele of the hernial sac*. When part of a scrotal hernia is found to fluctuate, and on pressure urine is evacuated or the patient experiences a strong desire to micturate, the surgeon may diagnose a *cystocele*, that is, a hernia containing a part of the bladder. This form of hernia is rare in the male, and quickly becomes "irreducible"; in the female, under the form of a vaginal protrusion, it is more common. When a femoral hernia in a female contains a small ovoid solid body which is irreducible, tender on palpation, and becomes painful during the menstrual period, it is an ovary in the sac. This must not be confused with the localized deposit of extraperitoneal fat often found over femoral hernial sacs.

Reference may here be made to the diagnosis of *umbilical epiplocele*, which has to be distinguished from a subcutaneous lipoma and an outgrowth of subperitoneal fat. All alike consist of soft, rounded, lobulated masses of fat. If the tumour is freely movable in the belly-wall, quite irreducible, and without an expansile impulse, it is a *subcutaneous lipoma*. If the tumour on its deep aspect is fixed to the belly wall, is not and never has been reducible, and has no expansile impulse on coughing, it is a *subperitoneal lipoma*. If the tumour is fixed deeply to the belly-wall, is or has once been reducible wholly or in part, and has an expansile impulse on coughing, it is an *epiplocele*. In some cases it is impossible to distinguish between the last two tumours without operation.

Pathological varieties of hernia.—1. If the hernial tumour entirely disappears on lying down or on gentle taxis, slipping up into the abdomen and remaining lost there, redescending on coughing or on assuming the vertical position, it is a *reducible hernia*. After reduction the surgeon may feel the sac of a hernia as a more or less marked thickening of the part, and also the canal or ring through which the hernia has passed, but he should not be able to feel any tumour or special resistance within the abdomen. If on emptying the external hernial sac a tumour or sense of resistance is felt in the adjacent part of the abdomen, it shows that there is a *double sac*—"hernie en bisac."

Supposing the hernia or any part of it is not thus completely reducible, the surgeon should learn the age of the hernia, how long it has been unreduced, whether it is now larger than usual, and, if so, whether that increased size is the result of a strain or effort, or is quite spontaneous. He should examine the tumour, noticing its tension, outline, and sensitiveness, whether there is any impulse on coughing, or fluctuation, and whether it is dull or resonant on percussion. He should inquire when a motion was last passed, and whether flatus has been passed since; if vomiting has occurred he should examine the vomited matter to estimate from what part of the alimentary canal it has been regurgitated, and he should also learn the frequency of the vomiting, and examine the belly for distension and tenderness. Finally, he should investigate the patient's general condition, his facies, pulse, temperature, tongue, and urine.

2. If the hernial tumour is not tense and is free from all signs of inflammation, and has an impulse on coughing, and there are no signs of intestinal obstruction, it is a *simple irreducible hernia.*

3. If there has been a sudden formation of a hernial tumour, or a sudden enlargement of an old hernia from some strain or effort, and if the tumour is tense, irreducible by gentle taxis, and there is no impulse on coughing, the hernia is *strangulated.* It is very important to remember that the acuteness of the symptoms of strangulation of a hernia varies within wide limits; there may be hardly any pain or tenderness, or this may be quite severe, the pain being referred to the umbilical region. The signs of intestinal obstruction may come on slowly, or may be well marked from the onset, the bowels being absolutely confined, neither flatus nor fæces passing, vomiting being early, frequent, and soon stercoraceous, and attended by collapse. Tension of the tumour, irreducibility, and loss of expansile impulse on coughing are invariable signs of strangulation. When the parts around the strangulated hernia become swollen, purplish, and œdematous, and the vomiting ceases and is replaced by hiccough, the patient becoming cold, livid, and very collapsed, *gangrene of the hernia* is to be diagnosed. Should a patient with an unrelieved strangulation suddenly complain of acute pain in the belly, and the collapse be notably increased, and this is quickly followed by distension of the belly, pain in the back, and great abdominal tenderness, *rupture of intestine and acute peritonitis* must be diagnosed.

A small, tense, irreducible femoral or obturator hernia associated with passage of fæces and flatus is *Richter's hernia,* in which only a part of the circumference of the bowel is engaged in the hernia. The local features are those of a strangulated hernia, but the signs of complete obstruction are wanting. This form of hernia is not very rare, but the typical symptoms are very seldom met with. Meckel's diverticulum when strangulated may give the same combination of symptoms as Richter's hernia.

4. If an irreducible hernia has suddenly become larger, is heavy and full, but is tympanitic on percussion and gurgles when manipulated, and if the surgeon finds that there is but slight, if any, tenderness and no marked collapse, only a sense of fullness of the belly, with nausea and vomiting when food is taken, it is an *obstructed or incarcerated hernia.* There is usually a history of constipation, or of a large and indigestible meal, and, although the bowels are confined, flatus is passed, and there is usually a slight impulse on coughing to be detected in the hernia. This condition is met with most often in large irreducible hernias, either umbilical or in the left groin, and in patients who are careless about the regular action of the bowels.

5. Whenever a hernial tumour shows signs of inflammation (redness, swelling, local heat, pain and tenderness, with fever), it is an *inflamed hernia.* This may be due to local or general peritonitis set up by injury or appendicitis, to obstruction, or even to strangulation and gangrene of the contents of the sac; in all cases the cause of the inflammation must be ascertained.

Effects of taxis of a strangulated hernia.—When during taxis a hernial tumour yields with a sudden slip and a gurgle, and the contents pass into the belly and leave the canal clear (except for the presence of the sac), and there is no unusual resistance or swelling to be felt above or adjacent to the canal, the surgeon may be satisfied that the *hernia is reduced.*

False reduction is of three forms: (1) emptying an external pouch or sac into an internal pouch or sac in "hernie en bisac"; (2) rupture of the sac and displacement of the contents through the rent in the sac; (3) displacement of the sac and its contents—*réduction en bloc.*

Should the hernia yield gradually, go up bodily without a gurgle, and leave the ring unusually free (no sac being in it), the surgeon must suspect *réduction en bloc;* and if, on pressing his finger well up into the canal, or examining the part either through the abdominal wall or from the rectum or vagina, a tumour or sense of resistance is met with, and if the symptoms of strangulation persist, this diagnosis becomes established. *Réduction en bloc* may be very easily effected, even by the patient himself.

If, in attempting to reduce a hernia which has been some time strangled, the tumour yields under the fingers but does not disappear, and the outline and tension of the parts are altered, while at the same time the patient becomes more collapsed, the surgeon is to diagnose rupture of the intestine.

Symptoms of peritonitis coming on or persisting after satisfactory reduction of a strangulated hernia indicate either (*a*) a perforation of the intestine following ulceration at the point of constriction, or (*b*) gangrene of a coil of intestine without perforation.

CHAPTER XLII

DIAGNOSIS OF DISEASES OF THE ANUS AND RECTUM

It is necessary to discuss the diagnostic value of the symptoms of anal and rectal disease; but, although this is done, it cannot be too clearly stated that a diagnosis should never rest upon such data, for in every case a careful and thorough exploration of the parts is necessary. The symptoms may enable a surgeon to *guess* the nature of a patient's malady, but only a careful examination will enable him to arrive at a *diagnosis*.

Pain is perhaps the most frequent of these symptoms. It may be an *itching*, which if severe is known as *pruritus*; this is particularly associated with external piles, herpes, erythema or eczema of the anus or adjacent skin, external fistula, ascarides, constipation, and sexual irregularities. When *throbbing* in character it is generally due to acute inflammation and abscess, or to strangulation of prolapsed piles or mucous membrane. When *colicky* in nature and *preceding* and *accompanying defæcation*, it is generally caused by ulceration of the bowel. When of a dull *gnawing* character with acute exacerbations of severe burning or shooting pain which are caused by and continue for a long period after defæcation, it is due to an irritable *ulcer* or *fissure* of the anus. Pain in the region of the *sacrum* is often due to malignant disease of the bowel, and when to it are added pains shooting down the thighs this indicates that the disease is implicating the sacral nerves. *Tenesmus* is particularly caused by polypus and foreign bodies in the rectum, prolapse, constipation, dysentery, stone in the bladder, and hypertrophy of the prostate.

The motions.—Much may be learnt by an examination of the motions passed, and in many cases the surgeon himself should make a careful examination of the stools. The most important points to observe are the size, shape, continuity, and amount of the fæcal matter, and the admixture with it of mucus, blood, or pus. The size of the motion is a measure of the calibre of the rectum and anus; even the occasional passage of a full-sized motion excludes a stricture of these parts. The breaking-up of the motion into small pieces is a very frequent effect of growths in the bowel as well as of constipation. The motion may be flattened by stricture of the bowel, or by compression from without, as in tumours of the uterus and prostate.

Diarrhœa, in the sense of the passage of the intestinal contents too hurriedly and in too liquid a form, is not a symptom of rectal disease; but in the sense of a too frequent evacuation of the lower bowel it is a common symptom of rectal ulceration, which induces it either by the active peristalsis excited by the contact of fæces with the ulcerated surface, or by the amount of mucus, serum, or blood poured out from the diseased surface. A frequent discharge of mucus, mixed with more or less fæcal matter, may occur in cases of fæcal accumulation in the rectum; it is also an important symptom of acute periproctitis, and occurs in pelvic appendicular abscess. Indeed, this symptom is so commonly associated with rectal obstruction that it should invariably suggest to the surgeon the necessity of a thorough exploration of the rectum.

Constipation is quite as often a cause as a consequence of rectal trouble; it appears to induce piles, certainly promotes thrombosis in external piles, and increases the hæmorrhage from internal piles, and it is regarded as a cause of anal abscess, of fistula, and of fissure. The affections of the rectum which lead to it are painful fissure of the anus (owing to the dread with which the pain of defæcation is regarded), stricture of the anus or rectum, and atony of the bowel by which its expelling force is diminished; when this produces impaction of fæces, it may set up a spurious diarrhœa. The association of "spurious diarrhœa" and "constipation"—by which is meant the frequent passage of fluid containing the merest trace of fæcal matter—is frequently met with, and should never be overlooked by the surgeon; it points to fæcal impaction, or to a stricture of the bowel.

Discharge. (*a*) **The time of its appearance.**—If discharge is constant and independent of the act of defæcation, its cause is extrarectal, either prolapsed piles, mucous patches, eczema, ulcer, or fistula; in the last case the discharge may be increased by the pressure of the fæces during defæcation. If, however, discharge only attends an expulsive effort of the bowel, it comes from some intrarectal affection, such as polypus, piles, internal fistula, fissure, ulcer, or growth. This distinction does not apply in cases of very relaxed patulous anus where the sphincter muscle has so lost its power that the contents of the bowel can escape freely.

(*b*) **The nature of the discharge.**—Pure unaltered blood, in the absence of injury, points to internal piles, to polypus, or to a ruptured varix or nævus of the rectum; hæmorrhage in a child is nearly always due to polypus, occasionally to intussusception; a streak of blood upon the motion is characteristic of anal fissure. A discharge of *altered blood*, brown or dark in colour, and having a peculiar penetrating fetor, is met with especially in malignant disease of the bowel and in dysentery; *blood and mucus* mixed together may come from the congested mucous covering of an intussusception, or from a growth in the bowel. *Mucus* is discharged from the bowel in some cases of polypus and of ulcer, and also from internal piles, from congested or chronically inflamed mucous membrane, and in cases of periproctitis. In some very soft malignant growths of the bowel there is a profuse discharge of mucus. *Pus* specially indicates abscess or fistula opening into the bowel, or anal ulcer; it is sometimes seen in cases of rectal ulcer. A thin *watery discharge* attends the disintegration of malignant growths, being often mixed with more or less broken-down blood. The escape of *gas* (not through the anus), felt by the patient as a fine crackling or bubbling, is a sign of a complete fistula, as is also the escape of fæces mixed with pus from a similar sinus. If a fistula discharges much pus, the fact shows that its cavity is extensive.

Protrusion from the anus, if constant, points to the presence of external piles or to a malignant growth at the anus; if it only attends the act of defæcation or other straining effort, it is more probably internal piles, polypus, or prolapse. The greater the ease and frequency with which the descent occurs, the greater the probability of the affection being prolapsus, with or without either of the above affections superadded.

The examination.—Before making a thorough and complete examination of the parts, the rectum should be cleared by an enema carefully given, unless the symptoms point to a stricture; and where there is any reluctance on the part of the patient to submit to the examination, or a satisfactory examination cannot otherwise be made, an anæsthetic should be administered. This examination may be made in one of five positions: (*a*) With the patient lying on his left side with the thighs well flexed and the perineum directed towards a good light. (*b*) With the patient on his back with the hips raised on a pillow above the level of the shoulders, and the thighs well drawn up and separated. (*c*) In the case of men to whom an anæsthetic is not administered, the patient may be made to stand close against the back of a chair, and then bend down over it to the full extent; in this way the anus and the parts around it can be very conveniently explored, and if the patient is tractable the interior of the bowel can be readily examined. (*d*) A similar position is obtained by getting the patient to kneel on a couch with the head and shoulders low and the thighs vertical. (*e*) It is occasionally useful to examine the rectum with the patient standing with the right thigh flexed; in this position a growth high up may be felt when out of reach of the finger in either of the other positions.

The parts around the anus should first be explored by gently holding aside the gluteal folds; then the anus itself should be examined by everting its edge and getting the patient, if conscious, to "bear down" as in the act of defæcation; and lastly, the interior of the bowel should be examined with the finger, a speculum, or both.

1. **Examine the parts around the anus,** noticing particularly any redness, swelling, ulceration, or dis-

charge. If there is a diffused bright redness of the surface extending all round the anus, and on to the buttock, or forwards to the scrotum, without any swelling, discharge, or pain other than itching, it is *erythema*. If in a young child, this is due either to want of cleanliness or to congenital syphilis, and the surgeon should look carefully for mucous patches here and elsewhere, and for other evidences of syphilis. In adults it is mostly seen in stout persons, and the part may be moistened with sweat. If the surface around the anus is of a duller red colour, not swollen, but thinly covered with fine yellowish scales or scabs, or of a sodden appearance, it is *eczema*. If the redness is not in the form of a diffused patch, but of an annular eruption, and if it is chronic and attended with much itching, it is parasitic erythema, or *erythema marginatum*.

If there is a limited area of bright redness, which is swollen, very painful and acutely tender, it points to acute inflammation of the skin and subcutaneous tissue, and if fluctuation can be detected in it, it is an *abscess*.

If the abscess is quite close to the anus and superficial, it is an *anal abscess*.

If the swelling is deep, attended with much induration, and the finger introduced into the bowel feels the ischio-rectal fossa filled up, and fluctuation can be detected between the external swelling and the finger in the bowel, it is an *ischio-rectal abscess*. This may be either acute or chronic. If acute, its development is attended with great pain and considerable fever, and the contained pus has the odour distinctive of *B. coli* infection. If chronic, it is tuberculous and secondary to tuberculosis elsewhere.

If there are one or more circular or oval flat elevations of the surface, of a milky-white or opalescent appearance, with a moist smooth surface into which the probe does not sink, they are *mucous patches*, and the surgeon will find the *Spironema pallidum* in the discharge. Finely papillated outgrowths from the skin, in between the branching divisions of which a probe sinks, are *warts. Sebaceous cysts, dermoid cysts, fatty tumours, melanotic sarcoma*, and *tumours growing from the coccyx* are occasionally found in this situation. Both hard and soft *chancres* are also met with in this region; for diagnosis, *see* p. 622.

If a bead of pus or discharge is seen welling from a point of skin, a fine probe should be carefully pressed against it, and it will probably enter a sinus; or the opening of a sinus may be at once conspicuous, or may be found beneath a small firm elevation or fold of the skin. Having found a *sinus*, the surgeon must carefully pass a probe along it and determine its direction and nature; if fæcal matter or flatus is seen or known to pass along it, or if the probe passes in towards the bowel and its point is felt by the finger in the rectum, it is a *complete fistula*. If, however, the probe passes towards the bowel but cannot be made to enter without forcing its way through the mucous membrane, and the finger in the bowel fails to detect any internal aperture of the sinus, it is an *incomplete or blind external fistula*. The surgeon may find the probe pass circularly round the anus, or in more than one direction, showing that it is a *horseshoe fistula*, or a *branching fistula*. It must be remembered that the thin skin quite close to the anus is so loosely fixed to the subjacent parts that the probe can be easily made to pass beneath it round the anus when no sinus previously existed there; but when the part is laid open by the knife, an old sinus lined by granulations on a base of firm fibrous tissue is at once distinguishable from the track a probe has forced for itself in cellular tissue.

It is important to remember that the firm wall of a fistula *can always be felt as a cord* by the finger; and the knowledge thus gained will not only enable the surgeon at once to pass the probe in the right direction, but will help him to recognize the presence of lateral diverticula from the main track. Fistulæ are often multiple, and their external orifices may be very small, even minute, too small to admit a common probe; and where there is any constant moisture of the part or other sign of fistula, a most careful examination with the finger to detect a firm cord, and with a fine probe, must be made and even repeated. The neighbourhood of small papular elevations must be specially explored, as the orifice of a fistula is often hidden in or under such a nodule.

But the sinus may pass quite away from the bowel towards the sacrum or ischium, or up into the cavity of the pelvis, in which case an area of *necrosis*, or disease of the *sacro-iliac joint*, or of the *hip-joint*, must be sought for. The examination of this region should be completed by the surgeon pressing with his finger on each side of and all round the anus; if he detects any unusual resistance or induration, and particularly if the skin over it is slightly reddened or livid, he should suspect an *incomplete or blind internal fistula.* By pressure pus may be made to ooze from the anus, or may be seen flowing into the rectum when a speculum is passed, or the internal orifice may be felt and a probe passed into it and made to present under the skin; any one of these signs will make the diagnosis certain. *Ascarides* may be seen around the anus.

2. **Examine the anus.** — If the anus is found re-

tracted and tightly closed by the sphincter, with deep radial folds around it, the spasm is probably due to an irritable ulcer, and the patient should be encouraged to force down as in defæcation, and at the same time the surgeon should gently evert the opening, when a *fissure* will probably be seen with a small fleshy nodule of thickened skin—a "sentinel pile"—at its outer end. This fissure is most common at the posterior border of the anus; there may be more than one. The symptoms of this very important affection are severe gnawing pain during and especially after defæcation, the pain being in the anus and spreading from it down the thighs, a streaking of the fæces with pus or blood, and a slight purulent discharge. Whenever there is severe pain after defæcation, or the passage of the finger into the anus causes acute pain, suspect fissure.

There is another condition liable to be mistaken for spasm, and that is *stricture of the anus*; in this the anus is not retracted, anæsthesia in no way lessens the resistance offered to the passage of the finger, and the rectal evacuations are always small. This is seen in children as a congenital affection, and in adults as the result of badly devised operations in which the cicatrization of the wounds has narrowed the orifice. Epithelioma of the anus may obstruct the outlet.

A *patulous anus*, offering no resistance to entrance of the finger, or to the escape of flatus, fæces, or discharge, may be due to a lesion of the spinal cord (*see* Chap. VIII.), or it may be the result of the constant stretching of the sphincter by prolapse of the bowel, or of an operation, particularly a double complete division of the sphincter, or it may be due to the presence of a stricture in the rectum of such a nature as to act the part of a sphincter.

Swellings at the verge of the anus must be carefully and critically examined. The lining of the orifice may be swollen more or less uniformly, of a somewhat bluish-white colour, with very superficial abrasions, the condition being attended with itching and smarting; this is known as *eczema of the anus.* *Mucous patches* may be found at the verge of the anus resembling those seen on the skin around it. Of the remaining swellings, three forms of isolated, distinct little tumours must be distinguished. First and most common is a solid flaccid fold or tab of skin, incompressible, and not tender—*anal tabs.* Then there are rounded, soft, smooth, compressible swellings of a bluish colour, which are dilated hæmorrhoidal veins covered externally by skin—*external hæmorrhoids.* The third form is a tense, firm, globular, very painful and tender swelling, deep blue in colour on the inner surface, with more or less redness and swelling of the skin; this is a *thrombosis* of a hæmorrhoidal vein, known as an *inflamed external hæmorrhoid,* or more commonly as a "thrombosed pile."

The swelling, however, may take the form of an indolent infiltrating swelling without marked projection of the surface, and more apparent to touch than to sight. If it is an ill-defined thickening of the skin and subcutaneous tissues, painless, with slight livid-red discoloration of the skin, or the skin is ulcerated, with a firm yellowish-white slough forming the floor of the ulcer; or if there is independent ulceration of the bowel, *gumma* of the anus, or *ano-rectal syphiloma,* is to be diagnosed; a positive Wassermann reaction and other evidence of syphilis confirm the diagnosis. If, however, the induration is more nodular, or assumes the form of an ulcer having thick everted edges and firm uneven base with small warty excrescences, and the inguinal glands are enlarged, it is *epithelioma of the anus.*

Lastly, the surgeon may find that there is a *protrusion from the anus.* He must examine any such protrusion carefully to notice whether it consists of the everted mucous membrane of the bowel, and whether there is or is not a groove or sulcus between the protrusion and the anus, and whether there is an orifice at the end of the protrusion. If the mucous membrane covering the protrusion is directly continuous with the skin of the anus, it is either a simple prolapsus or prolapsed internal hæmorrhoids, and this must be decided by detecting low, soft, sessile, deep-red or livid projections from the surface of the membrane, which prove the case to be one of *prolapsed internal hæmorrhoids;* if no such vascular outgrowths are seen it is a case of *simple or partial prolapsus.*

If, however, the finger or a probe can be introduced into a sulcus around the base of the protrusion, it is a case either of complete prolapse or of polypus, and this can be decided by noticing whether or not there is an orifice at the extremity of the projection. If the projection has an orifice at its extremity, and is covered by normal mucous membrane, it is a *complete prolapse,* or *procidentia recti.* This will be distinguished from the partial prolapse, or prolapse of mucous membrane only, by the sulcus round its base, by the fact that it is marked by circular folds in the mucous membrane, by its greater size, and often by its greater length; when it is of old standing, and one that has been habitually down, the mucous membrane becomes drier than normal, approaching the condition of skin.

If the finger passed into the sulcus round its base can feel the reflection of the wall of the rectum on to the prolapse, it is usually called *prolapsus* or *procidentia;* but if the finger cannot reach the bottom of the sulcus, or feel this reflection, it is spoken of as an *intussusception.* When the projection is large the surgeon may be able to feel the gurgling of coils of small intestine within its anterior part. In rare instances *a stricture of the rectum* may be forced down through the anus; the character of the orifice, its induration or ulceration, may indicate the nature of the case, but after reduction the diagnosis will be readily made.

If the patient complains of severe pain and of inability to replace a projecting mass, and if it is œdematous and swollen, livid in colour, or perhaps even black and gangrenous in places, it is a *strangulated prolapsus,* in which *strangulated internal piles* can usually be recognized.

Where the projecting mass is solid, without any terminal orifice, it will be identified as a *polypus.* The most common variety of polyp is a bright-red, soft, pedunculated growth about the size of a cherry, found in children and young persons, consisting of adenoid tissue, and called the *glandular polyp ;* it causes hæmorrhage, and is *the* great cause of hæmorrhage in children; if strangled by the sphincter or associated with a fissure, there is acute pain. These polyps grow from the mucous membrane of the rectum proper. *Firm fibrous polypi* are found only in adults, in the form of smooth rounded growths with a slender and often a long stalk. They vary much in size, spring from the ano-rectal junction, and are also known as anal fibromata. *Villous polypi,* recognized from their velvety surface, rarely protrude from the anus. Small polyps may be found thickly scattered over the surface as far as the finger can reach. *Cancerous* masses are recognized by their hardness, their association with ulceration, and the fact that they infiltrate the wall of the rectum. Polyps are to be distinguished from internal hæmorrhoids by their being distinctly pedunculated, while piles are sessile, and also by the fact that their pedicle is attached well above the sphincter ani ; piles are swellings of the anal canal.

The verge of the anus should be carefully examined for *fistulæ ;* minute fistulæ in this situation are said to be not infrequent in syphilitic disease of the rectum.

3. **Examine the rectum.**—For this, the right forefinger, protected by a rubber finger-stall or glove and well greased, is gently introduced into the bowel, while the patient "strains down" to relax the sphincter muscle ; in this way the tone of this muscle can be determined. The finger should be passed in to its full length, and gently swept round the bowel, feeling especially for any narrowing of its calibre, any induration of its walls, and any breach in the smooth mucous surface ; by sweeping the finger round, a mucous or soft gelatinous polypus may be caught, or even have its pedicle torn across. It is necessary to use the utmost gentleness in this examination, where there is any ulceration of the surface, or stricture, as forcible pressure has been known to rupture the thinned and infiltrated bowel.

In the male, the prostate, the base of the bladder when full, and the vesiculæ seminales can be felt in front of the rectum ; in the female, the cervix uteri projects back towards the sacrum and is plainly felt through the rectal walls ; in both sexes, the sacrum and coccyx are felt behind, and the ischial spines and tuberosities at the sides. These parts, either in their natural condition or enlarged, must not be mistaken for disease of the rectum.

By means of a suitable speculum the interior of the bowel can be examined with the eye, and the characters of any ulceration or new growth, or projection from the surface, as well as the condition of the vessels of the mucous membrane, can be determined. It must be passed with care, and only after the finger has demonstrated the safety of passing it.

It will be most convenient to discuss first of all the diagnosis of those lesions which are revealed by the speculum, but which are not detected by the finger. Immediately within the anus the submucous veins may be found congested, tortuous, and enlarged, and visible as a venous plexus beneath the mucous membrane; this is best described as *hæmorrhoidal varix;* it is a common condition, and gives rise to itching about the anus, sometimes to hæmorrhage, and it may run on to the formation of piles. A *nævus of the rectum* may be met with as a livid, raised, soft, compressible, circumscribed swelling of the lining of the bowel; the only symptom it occasions is severe hæmorrhage from time to time; being a congenital disease, it will usually be found in children and young persons. These two affections will be distinguished by the position of the dilated vessels, and by the *nævus* forming a distinct soft bulging of the surface in which individual vessels are not perceived, while the *varix* does not form a tumour and individual veins are seen with clear spaces between them.

A very different condition is that in which the mucous membrane is found of a uniform deep-red colour without its normal glistening look, is hot to the touch, and occasions an aching or burning pain to the patient, and an increased secretion of rectal mucus; this is *chronic catarrhal proctitis.* Sessile deep-red projections from the mucous membrane of the anal canal are to be recognized as *internal hæmorrhoids;* these vary somewhat in appearance, some being very livid, others being of a bright-red colour and bleeding very readily; they are usually too soft to be detected by the finger, but if of long standing, and occasionally prolapsed and strangled, they may become firmer and distinctly palpable.

The various forms of *polypi* already mentioned may be seen by the speculum. The *villous polypus*, forming a sessile warty or papillated tumour, or consisting of numerous detached villi, and then called *polyadenoma*, may only be detected by this means of examination; it will be distinguished from cancer by the absence of induration of the rectal wall.

The inner orifice of a *fistula* may be seen, and a probe can be introduced to detect the course of the sinus; the orifice can generally be felt. The surgeon will recognize two forms of blind or incomplete internal fistula, in one of which the sinus passes outwards under the skin, causing induration and lividity by the side of the anus; while in the other the probe passes up along the gut, either in the submucous tissue, or outside the bowel in the superior pelvi-rectal space. By the thickness or thinness of the tissues overlying the probe in the sinus the surgeon will distinguish between the latter two. In some cases of *simple stricture* of large calibre the finger fails to detect the narrowing, owing to the absence of induration, but the contraction is rendered visible by the speculum; the size and shape of the opening, as well as its lack of dilatability, will at once enable the surgeon to diagnose it. The speculum will, of course, expose to view the anal fissures and irritable ulcers already mentioned.

The affections of the rectum which the finger detects may be grouped into *ulcers*, *fistulæ*, *compression* of the bowel from without, *stricture*, and *new growths* of the rectum.

Ulcers of the Rectum

An *ulcer* is detected by the absence of the perfect smoothness of the mucous lining of the bowel. The features to be specially recognized in reference to any rectal ulcer are—(*a*) whether it is the internal orifice of a *fistula* (this can only be determined by making an effort to pass a probe along it) ; (*b*) whether single or multiple ; (*c*) whether attended with other changes in the coats of the bowel. The ulcer may be found on an internal pile or polypus as a result of injury in the act of defæcation. Chronic ulceration of the rectum is very often the result of infection, and the surgeon must try to identify the particular organism concerned.

An ulcer found in a person known to be suffering from tuberculosis is probably a *tuberculous ulcer ;* and if the ulcers are multiple and there is slight thickening of the edge of the sore, or yellow tubercles are seen in the mucous membrane, or the tubercle bacillus is found in the pus, the diagnosis is established. Tuberculous fistulæ are often associated with tuberculous ulcers.

In other cases the amœba of dysentery, the gonococcus, or the *Spironema pallidum* will be isolated from the discharge, and the ulcer thus shown to be in the one case due to dysentery, in another to gonorrhœa, and in a third to syphilis. Where only staphylococci, streptococci, and the *Bacillus coli* are found in the discharge, one or other of them may be found to be more abundant or more vigorous than the others, and to be the probable cause of the ulceration.

If the ulcer has a thickened base, and an everted raised edge, with an uneven warty surface, it is a *cancerous ulcer.*

STRICTURES OF THE RECTUM

Lastly, we must speak of the diagnosis of the conditions leading to *narrowing of the calibre and induration of the walls of the rectum ;* these are often met with together, and are recognized by the finger. If the bowel is found to be narrowed, notice particularly the position and extent of the narrowing, the character of the mucous membrane at the seat of stricture, and whether there is ulceration or a nodular thickening of the mucous membrane. The rectum may be displaced or compressed by swellings or other pathological changes outside it; the commonest instance of this is hypertrophy of the prostate, which is recognized as a firm rounded mass bulging into the front of the bowel and causing troublesome tenesmus. Abscess in or around the prostate forms a very tender fluctuating tumour in the same position, and malignant tumours may develop in this situation, eventually infiltrating the walls of both the bladder and the rectum. Tuberculous vesiculæ seminales bulge into the bowel higher up, and tumours springing from the pelvis may compress the bowel. In the female a retroverted uterus, or a tumour of the uterus or ovary, may have a similar effect. In both sexes, but more often in women on account of the greater frequency of pelvic inflammation in that sex, the bowel may be bound down by firm fibrous bands. The surgeon will recognize these conditions by the position of the compressing masses, and by the other signs and symptoms occasioned by them, and particularly by noticing that the rectal walls are not infiltrated or fixed, but glide more or less freely over the compressing structures.

If about 1½ in. from the anus a narrow circular crescentic fold is felt, with healthy mucous membrane covering it, and there is no history of previous injury or disease, it is a *congenital fibrous stricture* due to imperfect fusion of the hindgut with the anus. It is more common in women than in men, and is usually noticed early in life.

The lower end of the rectum may be narrowed as the result of cicatrization of wounds, accidental or operative—*traumatic stricture.*

If the bowel is found narrowed and the wall a little hardened by irregular bands of unyielding tissue, the stricture is due to the *cicatrization of ulcers,* some of which may be found still present both above and below the healed ones. There may be a history of gonorrhœa, or of syphilis, or of dysentery, which will throw light upon the cause of the original ulcer.

If the surgeon discovers a nodular mass infiltrating and inseparable from the wall of the rectum, diagnosis of *cancer of the rectum* is to be made. The surface is usually ulcerated and uneven and bleeds more or less readily, so that there is a history of muco-sanious discharge. The growth may be annular and narrowing the bowel, or limited to one side and slightly polypoid. An annular growth is sometimes prolapsed into the bowel below and is felt as an intussusception with firm ulcerated or nodular surface; it may thus strikingly resemble to the touch some cases of cancer of the cervix uteri. The surgeon should carefully notice the situation of the growth, its vertical and transverse extent, the mobility of the rectum over the sacrum, bladder, prostate, vagina, and uterus, the degree to which the lumen of the bowel is narrowed, the presence or absence of secondary nodules in the bowel above or below the primary growth or in the cellular tissue behind the rectum, any enlargement of the inguinal or pelvic glands or of the liver, and especially any sign of obstruction, such as distension or tenderness of the colon and cæcum.

The relative proportion of growth and ulceration differs much: in some cases the bowel becomes completely blocked by the nodular masses of growth, while in other cases the neoplasm quickly ulcerates, and the rectum may be converted into a cancerous chasm with firm irregular walls, often extending into the bladder or uterus or vagina. Cancer in its late stages is not infrequently complicated with complete external fistulæ, which may open into the bowel above or below the constriction; recto-vesical fistula will be recognized by the escape of flatus and fæces with the urine, usually associated with great pain during and after the act of micturition. Recto-vaginal fistula is recognized by the passage of fæces through the vagina.

Cancer of the rectum is columnar carcinoma; it may extend into the anal canal and even project from the anus. It is common after the age of 45, but may be met with in quite young adults. Cancer originating in the anal mucous membrane is squamous carcinoma; it may extend a short distance up the bowel, but is more prone to extend towards the buttocks. Much less common than cancer of the rectum, it occurs only in elderly people.

Sarcoma of the rectum is occasionally met with. It is recognized by the large size of the tumour; ulceration is late, and hæmorrhage, when it occurs, is profuse. This condition can only be diagnosed with certainty by microscopical examination of a piece of the tumour. Simple tumours of the rectum also occur—adenoma, lipoma, myoma, and fibroma. They are recognized by their smooth outline, by their covering of unaltered mucous membrane, and by their non-infiltrating growth. With the exception of the polypoid variety of adenoma, simple tumours are very rare.

The finger in the rectum will readily detect masses of *impacted fæces*, or *foreign bodies* that may have been swallowed or introduced through the anus, or an impacted gall-stone. If after an enema has been given and returned the finger finds the bowel empty and its lumen enlarged, and it does not contract upon the finger, it is said to be "ballooned."

If the patient complains of severe burning, stinging, or shooting pain of a paroxysmal nature in the bowel or anus, and after a thorough examination of the bowel no local lesion can be found, and if there is no disease of the urinary organs, nor tumour in the pelvis, and particularly if the patient is subject to neuralgia elsewhere, the affection may be described as *neuralgia of the rectum.*

The **congenital deformities of the anus and rectum**, with one exception, have been considered at p. 560.

A congenital malformation which may be overlooked for some time is *narrowing of the anus* ; in this case the meconium escapes, but after a time attention is drawn to the fact that the fæces are passed with difficulty and that they are of very small diameter. The anus at birth should readily admit the surgeon's little finger.

CHAPTER XLIII

DIAGNOSIS OF DISEASES OF THE PENIS

Congenital malformations.—Defective development of the lower wall of the urethra, or **hypospadias**, results in the urethra opening at some point on the under-surface of the penis. Three varieties are met with: (1) *hypospadia glandis*, the meatus being situated at the junction of the glans and body, in the position usually occupied by the frænum of the prepuce, which in these cases is slit below and covers the glans like a cowl; (2) *hypospadia penis*, where the urethral opening is placed on the under surface of the body of the penis, which is usually stunted; and (3) *hypospadia perinealis*, or complete hypospadias, a condition in which the urethra opens in the perineum, associated with cleft scrotum and an imperfect development of the penis which resembles an hypertrophied clitoris. These patients are also known as **pseudo-hermaphrodites.** A cleft of the penis along the dorsum is known as **epispadias**; when complete it is associated with extroversion of the bladder.

The prepuce.—If the prepuce cannot be drawn back over the glans with ease and without pain the patient has *phimosis*. If, when the prepuce is drawn back, the glans is curved downwards, the frænum is too tight. If the prepuce, having been drawn back, cannot be replaced over the glans, the condition is known as *paraphimosis*, and when the constriction of the prepuce is tight a roll of œdematous mucous membrane rises up behind the congested glans, and still farther back the skin of the penis is swollen, while between these two swellings deep down in a sulcus is the tight margin of the prepuce. The prepuce is often too long, but if it can be properly retracted this condition is not phimosis.

Phimosis may be congenital or acquired. The *congenital* form is recognized by the history. It is due either to narrowness of the orifice preventing its passing back easily over the glans, or, more commonly, to adhesion of the prepuce to the glans. The condition can easily be recognized by attempting to draw back the prepuce. A very tight congenital phimosis may after a long time lead to great dilatation of the prepuce. *Acquired phimosis* may be caused by *œdema*, either inflammatory or part of a general dropsy, by *solid œdema*, by a *hard chancre*, by chronic balanitis causing *adhesion* of prepuce to glans, by *cicatrices* narrowing the orifice of the prepuce, by *growths*, or by *elephantiasis* or great *distension of the scrotum* by hydrocele, etc., dragging upon the sheath of the penis Any one of these conditions may be combined with congenital phimosis. Acquired phimosis is often met with in morbus cordis and chronic nephritis, gonorrhœa, chancre, primary syphilis, and after the healing of chancres of the prepuce. Solid œdema or hypertrophy of the prepuce may be caused by constitutional syphilis.

When under a congenitally tight foreskin a lump of stony hardness is to be felt, it is to be diagnosed as a *preputial calculus* ; if a probe is passed beneath the prepuce it gives a grating sensation as it touches the stone. These calculi are not to be confounded with the firm but yielding induration of a hard chancre, epithelioma, or gumma.

Discharge from the prepuce may be caused by balano-posthitis, urethritis, soft sore, primary syphilis, epithelioma, or warts. When the prepuce can be withdrawn the diagnosis is simple (*see* below), but if there is phimosis care is required to arrive at a right conclusion, and it may be necessary to slit up the prepuce to allow of an early and exact diagnosis. The orifice of the prepuce is to be well cleaned by syringing or careful wiping, and then the surgeon should endeavour to expose the meatus urinarius, and at the same time press forwards along the urethra : if pus is seen to flow from the urethra there is *urethritis ;* the pus should be examined for the gonococcus. A history of urethral discharge before the phimosis appeared, or of scalding pain along the urethra in micturition, or of chordee supports this conclusion, and if the meatus cannot be exposed the diagnosis may be made from these symptoms alone. If the discharge is sanious and not thick creamy pus, *soft chancre* is to be diagnosed ; the presence of chancres at the orifice of the prepuce, or the history of an ulcer before the phimosis, is strong corroboration of this diagnosis.

When the swelling of the prepuce is not uniform and a distinct induration is felt at one part only, and there are several indolent buboes in the groin, it is *primary syphilis ;* should the patient show the signs of secondary syphilis, the diagnosis is at once certain. In every case the discharge must be carefully examined for the *Spironema pallidum* (see p. 622). If, in a man over 30 years of age, there is a chronic progressive enlargement of the end of the penis, discharging a bloody watery fluid, and a red granular or fungating growth is seen inside the prepuce, or even ulcerating or fungating through it, it will be recognized as *epithelioma*, especially if the inguinal glands are infiltrated. A similar swelling with a thin discharge, in a young man, with a bright, florid, granular appearance of the growth, without any thickening of the base, would be *warts*. When the discharge is purulent in character, and is found not to flow from the urethra, and there is no localized induration of the prepuce, the condition is *balano-posthitis*. Where the inflamed prepuce can be drawn back the mucous surface is seen to be smeared with discharge, and presenting bright-red excoriated patches without any induration or ulceration.

Ulcers on the penis.—The following ulcers are met with on the penis:

Herpes.
Simple fissure.
Soft chancre.
Hunterian or hard chancre (primary syphilis).
Mixed chancre.
Gummatous ulcer.
Epithelioma.

The first question that must be answered in a case of ulcer of the penis is, Is the lesion a **hard chancre?** In many cases it quite clearly is not; whilst in others the signs of secondary syphilis—enlarged glands, a rash, sore throat, etc.—may be present and prove conclusively that it is. But, fortunately, it is possible to-day to make a certain diagnosis in most cases by demonstrating the presence or absence of the *Spironema pallidum* in the sore.

For details of laboratory methods of examining for the spironema, works on pathology or bacteriology must be consulted, but the following method needs no special apparatus; and, in view of the importance of the recognition of syphilis in its initial stage, we have thought it well to describe it here before proceeding to the general investigation of ulcers of the penis.

The surface of the chancre may be scraped, or, better, a fine pipette is driven into the sore. The fluid which passes into the pipette is allowed to settle, and a drop of the serum which separates from the corpuscles is allowed to fall upon a slide. This is mixed with a drop of distilled water and a drop of 1-per-cent. solution of Congo red or of Chinese ink. A film is made with another slide in the usual way and allowed to dry. When examined with a $\frac{1}{12}$-inch immersion lens the spironemas are seen as white spirals in a dark field. Their length is about twice the diameter of a red corpuscle, the spirals, eight to twelve in number, are tightly coiled, and the ends are pointed.

In any ulcer of the penis the surgeon should note the *age* of the patient, the previous history as regards *venereal disease* and *sexual intercourse*, the *initial stage* of the sore—whether a crop of vesicles, a pustule, an induration, a crack, or a wart—and the *number* of the ulcers. The sore must be examined to determine the amount of ulceration, the presence or absence of induration of its base and edge, and the amount of discharge. The glands in the groin must also be carefully examined and any enlargement, hardening, or fixation of them to the fascia or skin carefully noted.

1. If the sore is quite superficial, not extending through the mucous lining of the prepuce, is of recent origin, not indurated, and is attended with much itching and smarting, it is probably **herpes præputialis.** If the patient has suffered from similar attacks, and the affection is known to have begun in a group of tiny vesicles on a bright-red base, this

diagnosis is certain. The inguinal glands may be slightly enlarged in this condition.

2. A linear crack at the orifice of the foreskin, noticed immediately after connexion, which does not deepen or widen, and quickly heals up, is a **simple fissure**; this may be multiple and recurrent when there is phimosis; it is not infrequently seen at the frænum when that band is tight.

3. If an acute ulcer develops within a few days after exposure to possible infection, wears a punched-out appearance, with sharply cut edge, an excavated spongy base, without surrounding or subjacent induration, it is a **soft or non-infecting chancre.** This diagnosis is confirmed if the sore is known to have commenced as a pustule, if the ulcer is multiple, and fresh ulcers form from time to time where cracks or erosions are in contact with the abundant purulent discharge, if there is inflammatory enlargement of an inguinal gland, and if the spironema cannot be found. The detection of the causal organisms of soft sore is always difficult. *Sloughing phagedæna* and *serpiginous* ulceration may attack a soft chancre, but in many of such cases there is evidence of previous constitutional syphilis. All soft chancres leave depressed cicatrices.

4. If an ulcer has a smooth glistening base, a round sloping edge, thin watery discharge, and a sharply defined, firm, elastic induration around it which blanches on gentle pressure, it is a **hard chancre.** If the sore consists of a raised, flat, well-defined, elastic induration, either with or without ulceration, it is probably a hard chancre. The clearly defined, not very vascular induration is the special mark of the initial lesion of syphilis; it may vary from a small papule or thin paper-like plate in the deeper layer of the skin, to a wide, very dense mass, with

extensive ulceration. Additional evidence is afforded by noticing that the induration appeared from three to six weeks after infection (although there may have been a sore before), by the detection of multiple indolent buboes in both groins about the second week after the appearance of the induration, and by the appearance of the secondary eruptions and sore throat, etc. Although most commonly single, multiple chancres do occur. A chancre leaves a scarcely noticeable scar on healing. Confirmation of the diagnosis rests upon the detection of the spironema (*see* p. 622), and, after the lapse of a week or two from the first appearance of the chancre, a positive Wassermann reaction.

5. If an ulcer has at first the character of a soft sore, and later on specific induration occurs, it is a **mixed chancre,** and constitutional syphilis will follow. The surgeon cannot assure a patient of his freedom from syphilis unless a period of at least six weeks from the date of exposure to infection has elapsed without the development of a specific induration; the occurrence of a soft chancre in no way protects from or renders unlikely the subsequent development of a hard chancre.

6. If the ulcer is deeply excavated with undermined edge, and a tough or soft tenacious slough adheres to the base, and this has resulted from the softening down of a chronic induration of the penis in a man whose serum gives a positive Wassermann reaction, or who shows other signs of syphilis, it is a **gummatous ulcer.** There will not be glandular enlargement; the sore will yield to antisyphilitic treatment and leave a very depressed scar.

7. If the ulcer is chronic, and steadily progressive in spite of treatment, with a warty irregular hard

base, nodular everted edges, a foul watery or sanious discharge, and an infiltrating enlargement of one or more inguinal glands, it is **epithelioma.**

Phagedæna is the name given to an acute gangrenous, rapidly spreading inflammation of the penis, resulting, in persons with a low resistance, from a streptococcal infection superimposed upon a specific ulcer.

Gangrene of the penis may arise in the course of specific fevers, or from paraphimosis, phimosis with concealed chancre, or sloughing phagedæna.

Tumours of the penis may be grouped into the *superficial* and the *deep*. The surgeon should notice the mode of attachment or fixation of the tumour to the adjacent parts, and the history or signs of constitutional disease.

If the tumour is a sessile or pedunculated outgrowth from the skin or mucous membrane, with no surrounding induration, and with a branched irregular surface, florid and moist where covered by the foreskin, dry and hard where exposed, it is a **papilloma or wart.** These little growths are generally multiple, and usually follow urethritis or balanitis; they may attain a large size, and then, if exposed to friction, may ulcerate superficially. A **horn** may be found on either the prepuce or the glans penis.

A flat sessile outgrowth of slight thickness and moderate induration, with a milk-white eroded surface, is a **mucous patch.**

If the tumour infiltrates the tissue of the penis as well as grows from its surface, having a firm irregular outline, and a granular or warty surface, it is **epithelioma.** The patient is generally over 30. As a rule the growth quickly ulcerates, and spread to the inguinal glands occurs early. Cancer may grow out of sight under a tight prepuce, or by its bulk prevent retraction of the prepuce, and it may spread along the deep structures of the penis.

A firm or boggy induration in the prepuce or deep in the corpora cavernosa, which shows a tendency to adhere to the skin and to soften down, is a **gumma**; other evidence of syphilis and the effects of specific treatment confirm the diagnosis.

Very chronic indurations, which do not soften down, are movable under the skin, and situated apparently in the sheath of the corpora cavernosa, are **gouty indurations**; at least they are not gummata, they occur quite independently of syphilis, and are often associated with gout. Indurations of the penis are also found lingering for many months after injury to the part; they are sometimes spoken of as **thrombosis.** Inflammation may spread from the urethra and lead to intense and obstinate induration of the corpora cavernosa. All deep indurations of the penis cause chordee.

Scirrhus of the penis has been described; it will be recognized by its stony hardness, steady growth, and infection of the glands. **Melanotic tumours** also occur on the penis. A **mucous cyst** of the urethra may project from the urinary meatus.

Cicatrices on the penis.—The initial lesion of syphilis does not leave a permanent scar; soft chancre leaves a depressed scar which may after a time wear out; gummatous ulcers leave permanent depressed, thin, ill-nourished scars, often having much pigment in them. The extensive scars of phagedæna and of serpiginous ulceration are most common in the subjects of syphilis.

Diseases of the **urethra** are considered in Chap. XLVIII.

CHAPTER XLIV

DIAGNOSIS OF DISEASES OF FEMALE EXTERNAL GENITAL ORGANS

Inflammations. — **Vulvitis, vaginitis,** and **urethritis** are recognized by the discharge from the inflamed surfaces, as well as by swelling, redness, heat, and pain ; often all three coexist. To determine the existence of urethritis, the labia should be separated, and the meatus urinarius carefully wiped clean ; the finger should then be passed into the vagina and pressed along the urethra, when a drop of pus may be seen at the meatus. The discharge should be examined for the gonococcus and other organisms to determine the nature of the inflammation.

If a labium is swollen, reddened, œdematous, painful and tender, and is tense and fluctuates on the inner aspect posteriorly, it is an **acute abscess of Bartholin's gland.** If the signs of inflammation are less intense it is a **subacute labial abscess.**

A rapid sloughing of the vulva is sometimes seen in young children—**noma vulvæ.**

Tumours.—When, without any signs of inflammation, a fluctuating swelling is found bulging towards the orifice of the vagina beneath one of the nymphæ, it is a **cyst of Bartholin's gland,** or **labial cyst.**

A deep-red, painful and tender swelling at the meatus urinarius, attended with pain in micturition, is a **urethral caruncle ;** this tumour is most common in women of middle and late life. **Hypertrophy of the nymphæ** or great **enlargement of the labia,** with pendulous solid outgrowths, is not uncommon.

A chronic ulcer with an irregular granular or fungating base and firm edges, growing steadily, with enlarged inguinal glands, is **epithelioma.**

A small deeply pigmented tumour arising from the anterior part of the vulva, and bleeding early and severely, with rapid involvement of the inguinal glands, is a **melanoma.**

Ulcers.—Both *hard chancre* and *soft chancre* are common in this situation; for their diagnosis *see* pp. 622, 624. Occasionally, numerous small punched-out superficial ulcers are found on the inner surface of the labia, on the nymphæ, and on the clitoris, which result from the breaking-down of small superficial nodules; it is a rare disease, **follicular vulvitis.** Chronic ulcers with sloughy base and ragged edges are due to **late syphilis**; they may, when very chronic, be indurated, but the history and signs of constitutional syphilis distinguish them from the primary sore.

Mucous patches and erosions are common in the secondary stage of syphilis.

Degenerations.—There are two forms of degeneration of the vulva met with in elderly women. Both are characterized by intense pruritus or itching. **Leucoplakia** is diagnosed when the skin and mucous membrane of the vulva of an elderly and, usually, multiparous woman are found covered with red raw patches on which the epithelium becomes heaped up, and which then become white, scarred, and contracted, so that the whole vulval orifice is narrowed and the labia minora are smoothed out. Cracks and fissures are also found. If the condition is untreated, *epithelioma* develops. **Kraurosis** is much more uncommon, affecting only the labia minora and vestibule in young women, and is further distinguished from leucoplakia by the absence of cracks and fissures and of thickened epithelium, and by the greater contraction of the parts. Epithelioma does not follow.

CHAPTER XLV

DIAGNOSIS OF DISEASES OF SCROTUM, TESTICLE, AND SPERMATIC CORD

The scrotal tissues are freely movable over the testicle and cord, and this fact enables us at once to distinguish diseases limited to them from affections of the scrotal contents.

I. Diseases of the Scrotum

The presence of superficial *varicose veins*, of a *pendulous scrotum* from relaxation of the dartos, and of *hypospadias*, with vertical cleaving of the scrotum into two labium-like halves, each generally containing a normal testicle, is easily recognized. Want of development of the scrotum is associated with absence of the testicle from the scrotum, and may involve one or both sides.

Redness of the skin of the scrotum may be due to—

Intertrigo.
Eczema.
Erysipelas.
Syphilis.
Subjacent inflammation.
Blood-staining.

The surgeon should observe whether it is acute or chronic; a purely local affection or attended by signs of constitutional disease such as fever, syphilis, gout, and whether there is any sufficient local cause for the erythema, such as dirt.

If it occurs on the sides of the scrotum where it is in contact with the thigh, and is accompanied by a similar change in the skin of that region, the surface being constantly moist, it is **intertrigo.** This is most common in young children and in stout adults.

If the surface is moistened with a thin discharge which stiffens linen, and in places is covered with thin scaly crusts of dried discharge, it is **eczema.**

If the affection is acute and rapidly spreading, marked by a bright-red colour of the skin, with œdema, a tendency to vesication, smarting or itching pain with marked tenderness, and if it is associated with tender enlarged glands in the groins and with fever and severe constitutional disturbance, it is **erysipelas.**

Occurring in young children as a part of a coppery-red eruption involving the nates as well as the scrotum, with flat papules, and perhaps moist mucous patches, it is a manifestation of congenital **syphilis.**

The skin is reddened in acute **inflammation** of the testicle or epididymis, the signs of which are severe local pain, tenderness; and swelling.

The discoloration from **blood-staining** is readily recognized by its colour and by its not disappearing when compressed.

Swelling of the scrotum.—The surgeon must notice whether the swelling pits on pressure (*œdema*), fluctuates, or is solid.

Œdema may be local, or part of a wider œdema from nephritis, morbus cordis, or obstruction to the inferior vena cava. If *local*, it is inflammatory or urinary; when the swelling is attended with redness, pain, heat, and fever, and especially if it affects only a part of the scrotum, it is *inflammatory*, and may be erysipelas or a commencing abscess. If, however, the swelling has come on suddenly during an effort to pass water after a rupture or wound of the urethra, or has followed retention of urine from a tight stricture, or a perineal abscess, or a sudden discharge of pus from the urethra, and if the swelling is found to involve the anterior part of the perineum as well as the whole scrotum, it is *extravasation of urine.* The swelling will spread to the penis and up over the belly, but not on to the thighs or around the anus; patches of skin may become gangrenous; the pulse becomes rapid and weak, while the tongue gets dry and brown.

If the scrotal tissues are greatly thickened, very firm, with large wart-like projections from the surface, and this condition of "solid œdema" is the sequel to successive attacks of superficial erythematous swelling, it is *elephantiasis.* The parts often assume an enormous size, and the penis and the thighs may be involved. It is most common in natives or residents in Barbadoes, India, or tropical Africa, as the result of filariasis, but it may occur in persons who have never been out of England, idiopathically or as the result of operations on the inguinal glands or their destruction by inflammation.

A condition like elephantiasis scroti, but characterized by the presence of soft warty projections, which from time to time discharge a watery (lymph) or milky (chyle) fluid, is known as *lymph scrotum.* This is often associated with chyluria.

If the swelling fluctuates, and there is redness of the skin, with heat, pain, and surrounding œdema, it is an *abscess.*

If the swelling fluctuates, is tense, globular in shape, adherent to the skin in the centre, freely movable over the deeper parts, chronic and quite free from all signs of inflammation, it is a *sebaceous* *cyst.* Sebaceous cysts may be multiple. The white colour of the contents of the cysts usually shows through the thin skin. When small they form whitish, globular, firm projections from the skin.

Circumscribed solid tumours.—Flat dusky papules with fine desquamation of the surface are often seen during the period of *secondary syphilis*, and if these papules have a moist surface with a milk-white appearance, they are known as *mucous patches;* the *Spironema pallidum* can be found in the discharge, and there will be other signs of syphilis to corroborate the diagnosis.

If the papules are quite small, firm, and red in colour, and the skin around is pigmented and the seat of intolerable itching, the disease is *prurigo.*

A chronic warty growth in the skin, covered by a scab, which, when removed, exposes a red granular surface, is a *soot wart or epithelioma.* If the wart infiltrates the skin, and is found to spread slowly and to deepen, in spite of local treatment, and especially if an inguinal gland on the same side becomes enlarged, this diagnosis is established. Frequently there are several warts present, although one only may show the characteristic signs of epithelioma. This disease is most common in chimney-sweepers, and workers with tar and paraffin, and in men past 40 years of age.

A slowly growing tumour movable under the skin and over the testicle and cord, with a lobulated outline and well-defined edge, is a *lipoma.* If the tumour with these general characters is unusually soft and the outline is less well defined and not so lobulated as a lipoma, it is a *myxoma.*

Ulcers of the scrotum should be examined in the same way as ulcers of the penis (*see* p. 622); but special care should be taken to notice whether the ulcer is adherent to the testicle, or if it is the orifice of a sinus leading into the testicle.

If the ulcer is acute, sharply cut, with deep spongy base, red areola, and purulent discharge, and if it was noticed a few days after an impure coitus, or if it has developed in succession to similar sores on the penis, it is a **soft chancre.**

If the ulcer takes the form of a well-defined raised induration, with abraded or ulcerated surface, and a serous discharge, in which the *Spironema pallidum* is found, it is a **hard chancre.** There will be indolent buboes in each groin.

If the ulcer is chronic, sinuous or serpiginous, with depressed smooth base, or is in the form of a deeper chasm with undermined edges and a tough, yellow, sloughy base, it is a tertiary **syphilitic ulcer.** The blood serum will give a positive Wassermann reaction.

If the ulcer is chronic, slowly but steadily advancing, with induration of the base and around the edge, and a warty surface, it is **epithelioma.** One or more firm enlarged glands will be found in the groin.

Some ulcers are traumatic in origin or result from the separation of sloughs. **Sinuses** are either *urinary* or *tuberculous ;* in one case urine flows from them, and in the other there is tuberculous disease of the testicle or epididymis.

If the base of the ulcer is formed by the testicle which projects beyond the skin, it is known as **fungus testis,** or **hernia testis.** In such a case the character of the protruding mass, the part of the testicle adherent to it, and the discharge should be carefully examined.

1. If the base of the ulcer projects but little and is formed of granulations of a pale-pink colour, and the outline of the testicle is either unaltered or

only moderately enlarged, it is a case of *superficial fungus* due to a growth of granulations from the tunica vaginalis and tunica albuginea.

2. If the base of the ulcer is more prominent, of an ash-grey sloughy appearance, with a thin discharge in which spermatozoa are found under the microscope, and the outline of the testicle is greatly altered from more or less of its structure being protruded through the scrotum, it is *syphilitic fungus*, due to softening and sloughing of a gumma of the testicle, with protrusion through an opening in the skin. There will be a positive Wassermann reaction and other evidence of syphilis.

3. If the ulcer is on the outer side of the scrotum, with a pale-grey base formed by a protrusion from the epididymis, the rest of which is enlarged and nodular, it is *tuberculous fungus*. The discharge is thin pus with caseous or cretaceous flakes, and never contains spermatozoa. This form of fungus may occasionally be met with in connexion with the body of the testicle.

4. Fungus testis may follow the opening of any abscess in the testicle, and so may occur in the rare cases of acute orchitis which terminate in suppuration.

5. If the testicle is *greatly* enlarged, and all the signs of malignant disease (*see* p. 652) are present, with an irregular mottled mass protruding from an ulcerated opening in the skin, and an abundant sero-sanious discharge, it is *malignant fungus*. When a malignant tumour fungates through the skin, and bleeds freely from time to time, it is known as *fungus hæmatodes*.

Gangrene of the scrotum is most commonly caused by extravasation of urine; it also results from phlegmonous erysipelas, frost-bite, or thrombosis after acute fevers. Mortification of the entire scrotum, analogous to *noma vulvæ*, is occasionally seen.

II. DISEASES OF THE CONTENTS OF THE SCROTUM

The surgeon may find one or both of the *testicles absent* or *too small*, and, if so, he has to distinguish between the congenital and the acquired forms of these affections.

Absence of testicle.—If the corresponding pouch of the scrotum is and always has been small, and no scar is visible in it or in the groin, while there is no trace of testicle or cord to be felt, it is a case of *undescended testicle.* The surgeon must seek for the gland in the inguinal canal, the iliac fossa, the groin, or the perineum. (*See* p. 670.) If, however, a linear cicatrix is seen in the scrotum or groin, and the testicle cannot be found elsewhere, it is a case of *castration.*

Smallness of testicle.—This may be due to imperfect development, or to wasting of the organ. The surgeon should notice whether the whole testicle is absent, the vas deferens being entire, or if the body of the testicle alone is absent, or the body small; and, further, he should notice any scars in the scrotum or adhesion of the organ to the skin. Entire absence of a part is a congenital deformity; in wasting of the organ its remnant is always to be detected. A small size of the left testicle is not uncommon in association with varicocele, and is to be distinguished from wasting of the organ by the absence of softening or of nodular induration. The known causes of wasting of the testicle (affecting the body only) are acute inflammation, particularly in association with parotitis or injury, injury to the back of the head or spine, tuberculous disease of the same or of the opposite testicle, injury to the spermatic artery during or as the result of operation on or around the spermatic cord and aortic aneurysm blocking the orifice of the spermatic artery.

EXAMINATION OF INTRASCROTAL SWELLINGS

The first thing to determine about any scrotal tumour is whether the swelling is confined within the scrotum or extends up into the groin; to do this it is only necessary to seize the root of the scrotum between the forefinger and thumb; if the tumour is then felt to be entirely below the hand it is a *scrotal tumour*, but if a part of the tumour is felt to pass up between the finger and thumb it is an *inguino-scrotal tumour.* Two difficulties sometimes arise in applying this test: (1) A scrotal tumour may be so large and fill out the scrotum so fully that it is difficult, or even impossible, to seize the scrotum above it: in such a case it is enough to feel along the inguinal canal to determine whether the swelling extends into it, or not. (2) In many cases of what are regarded as scrotal tumours the spermatic cord is enlarged: such enlargement must not be mistaken for an actual extension of the swelling up into the groin.

Inguino-scrotal swellings will be considered in the next chapter; here the **diagnosis of purely scrotal swellings** will be dealt with.

Having determined that the swelling is wholly contained within the scrotum, the next point to clear up is **its relation to the testicle and cord.** First try to find the testicle, which will be recognized by its size, shape, consistence, and the special sensation experienced by the patient when it is compressed. In some cases the testicle can be seen. If the testicle can be separated from the swelling, notice whether they are connected at any part. In the same way determine whether the swelling is separable from the spermatic cord or forms a part of it. It must be borne in mind that swellings of the tunica vaginalis surround the testicle, and if tense prevent the palpation of that organ, and are inseparable from it.

The second great fact to determine about a scrotal swelling is whether it has any connexion with the abdominal cavity, and of this there are two signs—an "impulse" on coughing, and reducibility.

Hold the swelling lightly between the fingers and thumb, and get the patient to give a vigorous cough: if a sudden enlargement of the part is felt, it is an **impulse.** The movement in a stout or pendulous abdomen must not be mistaken for an impulse. An impulse in a scrotal swelling shows either (1) that intraperitoneal fluid is driven into it by the forced expiration of the cough, or (2) that the impediment which the cough offers to the venous return from the part causes a venous distension that can be felt. To test for **reducibility** the patient must lie on his back, and the surgeon should raise the scrotum and then gently compress the swelling. If by this means it is reduced in size or disappears, it shows that it partially or wholly consists either (*a*) of fluid which can be returned into the peritoneal cavity, or (*b*) of venous blood which can be emptied into the spermatic veins.

Having cleared the ground by this examination, we have to notice the general characters of the tumour—its size, shape, consistence, sensitiveness, the signs of inflammation or of infectivity, the state of the constituents of the spermatic cord and of the inguinal, iliac, and lumbar glands, the existence of disease of the urethra, bladder, prostate, or seminal vesicles, and the history of the affection. To discuss the diagnostic importance of all these points would be to repeat much that will be found in Chap. XVII., but points which are of special interest in the diagnosis of scrotal tumours must here be noticed.

The *epididymis* must be distinguished from the body of the testicle; in the normal state this is quite easy, and it is to be noticed that enlargement of the epididymis, even when it attains a great size, does not obscure its outline, but that enlargement of the testicle proper soon blurs the outline of the epididymis so that it becomes indistinguishable. The fact, therefore, that the two parts of the organ cannot be distinguished is evidence that the disease is in the body of the testicle. Even where disease originating in the epididymis spreads to the testicle, e.g. tubercle, the separate outline of the epididymis can generally be made out.

With very rare exceptions disease of the *tunica vaginalis* is attended with fluid effusion into its cavity, and the fluid surrounds and obscures the testicle. A fluid swelling in the scrotum in which the outline of the testicle is lost is to be regarded, therefore, as an effusion into the tunica vaginalis. The size, shape, and tension of such swellings vary greatly; if small and lax the fluid may be displaced and the testicle felt through it. In some cases a part or even the whole of the serous sac over the testicle is obliterated, and an effusion into the unobliterated portion will then form a fluctuating swelling above the testicle and attached to it. The history of the case, and the character of the fluid in the sac, will enable a diagnosis to be made.

Serous effusions are generally *translucent*, if care is taken to stretch the scrotal tissues and so make them as thin as possible, and to use a strong light.

The best way to examine a scrotal swelling for translucency is to put the palm of the hand of the same side behind the scrotum, and by gently approximating the fingers and thumb stretch the scrotum over it; a bright light is placed on the side towards the thigh, when the surgeon, with his eye on the opposite side, will cut off the rays of light passing over the scrotum by using his free hand as a screen. When possible this examination should be made in a dark room. By holding the hand in this particular way the opaque penis is held aside, and the scrotal tissues are easily stretched.

A serous effusion may be opaque if the coverings are unusually dense; it may also lose its translucency by admixture with blood or a considerable quantity of fat. When examining a translucent swelling, care should be taken to notice any shadow that may indicate the position of the opaque testicle.

In examining the spermatic cord, pains should be taken to distinguish between an enlargement (1) of the cord-like vas deferens or (2) of the tortuous, compressible, worm-like veins, (3) a swelling of the cellular tissue of the cord producing a general fullness obscuring the outline of its several constituents, and (4) the addition to the cord of some adventitious structure, solid or fluid.

Scrotal swellings must first of all be separated into those connected with the cord, and those connected with the testicle and tunica vaginalis.

SCROTAL SWELLINGS OF THE SPERMATIC CORD

1. If the swelling is elongated, tortuous in outline, soft, compressible, easily reducible in the recumbent position, and opaque, it is a **varicocele.** This affection is almost invariably on the left side, and its characters are quite unmistakable. The swelling has

an impulse on coughing. If after reduction a finger is placed over the external ring, and the patient stands up, the swelling slowly fills from below. When a part of a varicocele is incompressible and irreducible, it is *thrombosed:* if this is recent, the part is tender.

2. If the swelling is tense, globular, smooth, translucent, and fluctuating, it is a **hydrocele of the cord**; and if on steady pressure this swelling is reduced, there is a narrow communication with the peritoneal cavity: such a hydrocele has been called a *water-bottle hydrocele.* A hydrocele of the cord may be so tense that fluctuation is very difficult to appreciate; it may be so small that the test of translucency cannot be applied. Like all swellings of the cord, it is fixed by gently pulling down the testicle.

3. If the swelling is solid, opaque, irreducible, soft, and lobulated, it is a **lipoma.** Great care is sometimes necessary to distinguish this from an irreducible epiplocele with a very small stalk of omentum extending into the abdomen. But with care the stalk, however small, can be made out, and there will usually be a distinct history of reducibility in the early stage of the affection. The lobulation of omentum is finer than that of a lipoma.

4. A solid swelling, softer than a lipoma, lobulated, and growing steadily, is a **myxoma.** Such a tumour may be multiple, or associated with myxoma of the subcutaneous tissue of the scrotum.

5. **Tuberculous** and **malignant growths** may occur in the cord; they are secondary to similar affections of the testicle, and hence the diagnosis is usually easy. The tuberculous deposits tend to soften, burst, and leave sinuses. The malignant deposits infiltrate widely, ulcerate, and fungate.

6. A large, ill-defined, irreducible, opaque swelling

of the cord forming rapidly after an injury or a severe strain is a **hæmatocele of the cord.**

7. Other affections of the cord are the uniform, tender enlargements of the vas in inflammation spreading from the urethra, the firmer and often beaded or nodular enlargements of the vas in cases of tuberculous epididymitis, the general fullness of the cord in malignant and other tumours of the testicle, and the extension up along the cord of malignant growths of the testicle. A **spermatic cyst** may be found in the cord; it is indistinguishable from a hydrocele until the fluid is drawn off and examined microscopically.

SWELLINGS OF THE TESTICLE AND TUNICA VAGINALIS

1. If the swelling surrounds the testicle, fluctuates, and is translucent, it is a **vaginal hydrocele.** Of this tumour several varieties may be recognized:

i. If the swelling has formed slowly and is irreducible, it is the common *chronic vaginal hydrocele.*

ii. If the swelling has formed rapidly and is attended with redness and œdema of the scrotum, pain and tenderness, it is an *acute vaginal hydrocele.* This is met with as a complication of acute epididymitis and as the result of infected wounds of the tunica vaginalis or of the injection of irritants into its cavity. The scrotal swelling and the tenderness of the parts often prevent the detection of translucency.

iii. If the swelling can be emptied into the abdomen, it is a *congenital hydrocele.*

iv. If the swelling extends some distance up the cord in an infant or young child, but is irreducible, it is an *infantile hydrocele.*

2. If the swelling surrounds the testicle, and

fluctuates in all parts, but is not translucent, it is an **opaque effusion into the tunica vaginalis.** Of this, again, there are several varieties, which may be thus distinguished. Inquire into the duration of the swelling, and especially whether there has been any sudden enlargement of an old swelling, or whether there has been any injury to, or operation upon, the part, and notice the condition of the scrotal coverings, whether they are thickened or hardened, or ecchymosed.

i. Where the swelling has quickly supervened upon an injury to the part, or has immediately followed a surgical puncture of the tunica vaginalis, it is a *vaginal hæmatocele.*

ii. Where a chronic swelling has suddenly enlarged, generally as a sequel to an injury, it is a *vaginal hydro-hæmatocele*, i.e. the result of hæmorrhage into a chronic vaginal hydrocele.

iii. Where the swelling is of very long standing, and the scrotal tissues are thick and firm, the opacity is probably due to calcification or other degenerative changes in the tunica vaginalis. The result of tapping the swelling will clear up the diagnosis.

iv. Where the swelling has all the usual characters of a chronic vaginal hydrocele, except its translucency, and there is no evidence of sudden increase of the swelling, nor of even slight injury, and the coverings of the scrotum are thin and supple, the opacity is due to a change in the fluid, probably to a considerable admixture of fat—*galactocele*, or *milky hydrocele*—possibly to a very great addition of *cholesterin.* Only puncture and examination of the fluid can determine the point.

3. If the swelling does not surround the testicle, but can be traced as a translucent fluctuating tumour distinct from the testicle, it is an **encysted hydrocele of**

the testicle, or **spermatocele.** Occasionally the lower part of a vaginal hydrocele sac becomes obliterated, and effusion, occurring into its upper part, forms a fluid swelling on the top of the testicle. The history of the case may enable the surgeon to make a correct diagnosis, but if not, the character of the fluid withdrawn on tapping makes it plain: the fluid of a chronic vaginal hydrocele is always yellow in colour; that of an encysted hydrocele is either colourless, or milky from admixture with semen.

Encysted hydrocele of the testicle may be multiple—we have seen as many as five on one side; the tumour in such a case is very irregular, and it may be quite difficult to identify the testicle. In other cases there is a vaginal hydrocele as well as an encysted hydrocele; then the latter is only detected after emptying the tunica vaginalis. An encysted hydrocele may rupture into a vaginal hydrocele, and then on tapping the swelling the yellow fluid may be a little opalescent and spermatozoa may be found in it.

In all cases of hydrocele it is essential to *determine the position of the testicle.* If the parts were previously normal, in vaginal hydrocele the testicle will be at the back and lower part of the sac. But if the testicle is rotated, it will be in front and at the lower part; and as there will be nothing in the history of the case or in the condition of the other testicle to indicate this, it must be determined by examination. A spermatocele is usually above or behind the testicle, but it may be on either side; if multiple they may surround the testicle. There are three means of determining the position of the testicle in a hydrocele:

(*a*) It is *more resistant* to pressure than is the fluid.

(*b*) It is *tender* to pressure, the patient experiencing a sickening sensation when the testicle is compressed.

(*c*) It is *opaque*. When determining the translucency of a hydrocele, always search for the opaque testicle.

SOLID SWELLINGS OF THE TESTICLE

In investigating any solid swelling of the testicle the surgeon must first determine what part of the organ is affected—epididymis, testis proper, or both —because the seat of the disease throws great light upon its nature. After this he must carefully note certain special features of the case, which in this organ, as elsewhere, aid in diagnosis; these are— (1) the mode of onset of the swelling and its rate and direction of progress; (2) the size, consistence, and outline of the swelling; (3) the sensitiveness of the testicle; (4) the involvement of the tunica vaginalis, scrotum, spermatic cord, prostate and seminal vesicles, and (5) the condition of the lymphatic glands. As enlargement of the testicle often arises from extension of disease from the urethra or bladder, or as a part of a general infection, the surgeon must examine the urethra, prostate, and bladder, and search for evidence of a general infection, especially for signs of tubercle, syphilis, gout, malaria, and mumps.

The exact position and shape of the swelling and the seat of tenderness will enable the surgeon to determine the seat of the disease, but it must be borne in mind that the testicle may be partially or wholly rotated on its long axis so that the epididymis may present at the side, or in front, of the body of the organ instead of at the back.

1. *The part of the testicle first affected.*—The epi-

didymis is the chosen seat of gonorrhœal and tuberculous disease, while the body of the organ is affected by these diseases only secondarily. The testis is the primary seat of syphilitic disease, of new growths, and of some of the rarer forms of inflammation—those due to mumps, gout, and malaria.

2. *Disease of the urethra, prostate, and bladder* is the most frequent cause of swellings of the testicle; in every case care should be taken to determine whether such is present. The disease may be very slight and unobserved by the patient, or there may be obvious urethral discharge, or a clear history of stricture, enlargement of the prostate, cystitis, urethral instrumentation, or vesical calculus; but if not, a specimen of freshly passed urine should be examined for flakes which, if present, demonstrate the presence of inflammation of the urethra; the flakes can then be examined for the gonococcus. The prostate should be massaged just before the urine is passed, to render this test more exact.

The discovery of urethral disease is very strong evidence in favour of the inflammatory and secondary nature of any testicular swelling, and also of the disease having attacked the epididymis first and chiefly, if not exclusively. In all cases where disease has spread from the urethra or bladder to the testicle the vas is found enlarged and often tender, and the patient may have noticed pain in the cord some hours before the pain in the testicle. The presence of urethral disease is not conclusive evidence of the nature of a testicular swelling, for tuberculosis often attacks the epididymis as a sequel to gonorrhœa—either with or without a preliminary gonorrhœal epididymitis—and a man with a stricture or enlarged prostate may possibly have also a new growth in the testicle; this, however, is a rare combination.

3. *The mode of onset and course* of the swelling. A sudden abrupt onset always indicates inflammation; new growths always originate insidiously. Some cases of "simple" inflammation have a quiet, unnoticed onset, and, on the other hand, tubercle, which is usually a very chronic malady, may begin abruptly and extend rapidly. The patient who suddenly notices a swelling of a testicle is very liable to assert that the swelling arose as suddenly. Arrest of the enlargement, still more its lessening, is very strong evidence of its inflammatory nature; rapid, painless, and continuous growth, in spite of treatment, is characteristic of tumour.

4. *Softening* of a previously firm swelling of the epididymis is very strong evidence of its tuberculous nature.

5. *Affection of both testicles* is common in syphilis and tubercle, less common in epididymitis secondary to urethral disease, and rare in new growths.

6. *Hydrocele.*—An acute hydrocele often complicates acute epididymitis and makes the swelling simulate acute orchitis. Chronic hydrocele often arises in connexion with syphilitic disease; it may also be found with tuberculous disease.

7. *Affection of the cord.*—Uniform tender thickening of the vas is evidence of inflammation spreading down from the urethra; very firm painless enlargement of the vas, or a beaded swelling of the vas, is characteristic of extension of tuberculous disease up from the epididymis; extension of the actual growth of the testicle into the tissues of the cord is seen in malignant disease. General swelling of the cord from fullness of the vessels is found in inflammation and in very vascular growths.

8. *The lymphatic glands* in the iliac fossa are enlarged in infective diseases or malignant growth

of the testicle, those in the groin in infective diseases or malignant growth of the scrotum.

9. *Adhesion to the scrotum* is met with in acute inflammation, in chronic inflammation with disintegration of the tissue, and in the later stages of malignant tumours.

10. The special "testicular sense" is quickly and completely lost in cases of new growth, and in syphilitic disease of the testicle.

Swellings of the epididymis.—A swelling of the epididymis which is associated with gonorrhœa or gleet and uniform thickening of the vas is **gonococcal epididymitis.** The signs of inflammation may be marked, slight, or altogether absent. A similar swelling associated with urethral instrumentation, stricture, enlarged prostate, or vesical calculus is an infective epididymitis due to extension of disease from the prostatic urethra. These "simple" inflammations all subside under the influence of rest and sedative treatment. Epididymitis very often leaves behind a small firm nodule in the globus minor, with obliteration of the lumen of the duct at this spot. Hydrocele may add to the total swelling of the part.

A swelling of the epididymis which comes on quite apart from any urethral affection, slowly progresses, and acquires a nodular outline or shows signs of softening, is **tuberculous epididymitis.** The swelling may remain localized to one part of the epididymis, but as a rule the whole organ is quickly involved, and after a varying interval, the epididymis of the other side also. A beaded enlargement of the vas, swelling of the seminal vesicle and the prostate on the same side, or the presence of tuberculous disease of the bladder, kidneys, lungs, or other organs, would afford important confirmation of the diagnosis. When a gonorrhœal epididymitis does not resolve under proper treatment, but after subsidence of the acuter symptoms slowly enlarges, and then softens, it has *become* tuberculous.

A small, firm, painless enlargement of the epididymis coming on within the first year of syphilitic infection and in the absence of any urethral disease is **syphilitic epididymitis.** The enlargement occurs first in the globus major; it may be bilateral; it is a very infrequent affection. A **gumma** is occasionally seen in the epididymis in cases of gummatous disease of the body of the organ.

A positive Wassermann reaction will be obtained in these syphilitic cases.

Swellings of the testis proper.—An acute, exquisitely tender and painful swelling of the body of the testicle is **acute orchitis.** If there is acute epididymitis present also, the orchitis is due to an extension of the epididymitis—*consecutive orchitis.* Care must be taken not to mistake the tender fluid swelling of an acute hydrocele for the far more painful and tender swelling of orchitis. If the swelling has quickly supervened upon injury of the testicle and the surgeon can certainly exclude urethritis, however chronic, it may be regarded as *traumatic orchitis.* When the patient has an acute swelling of a salivary gland, or has been exposed to the infection of mumps, and other causes can be excluded, it is *testicular mumps.* The swollen testicle may follow or precede the parotid swelling. Coming on in a very gouty patient, apart from and unassociated with urethritis, it is *gouty orchitis.* Both the local and general symptoms are much more severe in orchitis than in epididymitis; acute inflammation of the body of the organ is very generally followed by wasting of the organ; occasionally it culminates in an *abscess.*

It is in **chronic enlargements of the testicle** that difficulties in diagnosis, sometimes insuperable, arise.

A chronic enlargement of one or both testicles, involving the whole organ, of moderate size and of smooth ovoid outline, with aching pain and increased testicular sensibility, full cord, and thickened vas, in a patient with chronic disease of the deep urethra or prostate, is a case of *chronic consecutive orchitis.*

A chronic enlargement of the testicle in which the epididymis is much enlarged, irregular in outline, of craggy hardness at one part and perhaps softened at another, is a *chronic tuberculous orchitis.* The special distinguishing feature of these cases is the early and marked affection of the epididymis and the secondary extension to the body of the organ; and confirmatory evidence will be found in the thickening of the vas, in enlargement of the seminal vesicle and prostate, and possibly in evidence of tubercle elsewhere.

A chronic enlargement of the body of the testicle without affection of the epididymis, developing in the course of a few weeks, and then remaining stationary, in which the organ is found very firm, smooth or only slightly uneven, with loss of testicular sensation, and only slight, if any, common sensation, without thickening of the vas, is *diffuse syphilitic orchitis.* A history of syphilis, evidence of other syphilitic lesions, and a positive Wassermann reaction will confirm the diagnosis. The disease is often symmetrical, and associated with hydrocele. It must be borne in mind that chronic hydrocele often leads to some enlargement of the testicle, and after tapping the hydrocele the organ may feel larger than its fellow —this condition is to be distinguished from syphilitic sarcocele by the history of long-standing hydrocele, and by the absence of the marked hardness caused by the syphilitic disease.

A chronic enlargement of the testicle, with complete loss of testicular sensation, and without thickening of the cord, occurring in a patient who is the subject of tertiary syphilis, is a *gummatous orchitis*. A bossy outline, adhesion of the testicle to the scrotum, ulceration of the scrotum and exposure of a firm slough, and the Wassermann reaction are other facts that would support this diagnosis. A gumma of the testicle often attains a larger size than the commoner syphilitic orchitis.

A chronic enlargement of the testicle coming on insidiously with moderate pain and tenderness, and some fullness of the cord, in men who have resided for a long time in malarious districts, is *malarial orchitis*.

If the enlargement of the testicle is painful and tender, less hard than in syphilis, and the patient is a gouty man who suffers from dyspepsia, cramps, etc., it may be regarded as *gouty orchitis*.

A chronic enlargement of the testicle may be a **new growth**; in its earliest stage it is impossible to diagnose, and later on diagnosis may be very difficult, or possible only after an exploratory incision; quite late the diagnosis may become easy from the great size of the tumour, from secondary deposits, and from ulceration and fungus. The most important features of new growths are—(1) Their *insidious origin*: in some cases there is a history of injury, but there is then a lapse of weeks before the swelling is noticed; very occasionally a tumour is congenital. (2) *Steady and often rapid growth* in spite of rest and local or constitutional treatment: tumours vary in their rate of growth, the more malignant ones increasing very rapidly. (3) *Early loss of testicular outline and* *sensation:* tubercle may cause a lobed swelling of the epididymis, syphilis may cause slight nodular unevenness of the body of the organ, but only new growths cause a markedly bossy outline of the testicle; this sign may, however, be absent, or only very late in development; no other disease causes such early and complete loss of testicular sensation as does a new growth. (4) The *consistence* of the tumour: it is usually elastic, and not so stony as in syphilitic orchitis; it may be fluctuating, or so soft as to simulate very closely a fluid swelling; a difference in consistence at different parts of the swelling is very characteristic when present. (5) *Signs of spreading*, such as extension of the swelling up the cord or into the scrotum, and secondary deposits in the iliac, inguinal, or lumbar glands.

New growths of the testicle are nearly always *malignant*, and their exact nature—whether teratoblastoma, dermoid, sarcoma, or carcinoma—is, as a rule, only determined by inspection or microscopical examination after removal. They may be met with at any age, but are most common in middle age, i.e. at the very time when other solid enlargements of the testicle usually occur.

A swelling of the testicle of insidious origin and very slow growth, with an irregular or nodular outline, and differing in consistence and shape from the normal organ, without affection of the cord, glands, or scrotum, occurring in a patient who is free from syphilis, tubercle, gout, malaria, or urethral disease, is a *benign tumour* of the testicle. Solid benign tumours—*fibroma*, *myoma*, *fibro-myoma*—are all very rare. Cystic disease of the testicle gives rise to slowly growing multilocular cystic tumours. Other cystic tumours are rare; they include *dermoid cysts*, which may be recognized by the history of their presence at birth or in early life, and *hydatids*. Cysts containing *guinea-worms*, and *acephalocysts*, have been met with.

Diagnostic value of puncture of scrotal tumours.—In some instances it is impossible to determine the nature of a swelling without resort to an exploratory puncture. The cases in which this would be employed are chronic tumours without obvious signs of inflammation, and they particularly include cases of hydrocele with thickened walls, hæmatocele, malignant disease, hydro-sarcocele, and fibro-cystic disease.

Exploratory puncture is employed for three purposes:

1. **To ascertain the character of the fluid withdrawn.**—i. If the fluid is straw-coloured or greenish, slightly viscid, and richly albuminous, it is from a *vaginal hydrocele*. This may be altered by the admixture of blood, of cholesterin crystals, or of fat. It contains a large amount of albumin (6 per cent.).

ii. If the fluid is colourless and watery, containing only a trace of albumin, it is from an *encysted hydrocele* of the testicle, epididymis, or cord.

iii. If the fluid is opalescent, this appearance is due to the admixture of semen, and spermatozoa will be found on microscopical examination. The addition of acetic acid causes effervescence but no turbidity or precipitate. In cases where an encysted hydrocele of the testicle has ruptured into a vaginal hydrocele, spermatozoa may be found in the deposit from the straw-coloured fluid characteristic of the latter.

iv. If the fluid is definitely milky in appearance, it is due to the presence of fat—*galactocele*, or *fatty hydrocele*. On "standing," the fat may rise to the surface as a layer of "cream." The fat is soluble in ether, and under the microscope it appears in the form of granules or minute droplets.

v. If the fluid is mucoid, mixed probably with blood, it is from one or more of the cavities of a "cystic testicle." The addition of acetic acid causes turbidity from the presence of mucin.

vi. If only pure bright-red blood is withdrawn, it comes from a solid tumour of the testicle. The rapidity of escape will show the degree of vascularity of the tumour.

vii. If the fluid is altered blood, thicker in consistence and darker in colour, it is an old hæmorrhage (a hæmatocele).

viii. Fluid of a dark-amber colour is probably the contents of a hydrocele of a hernial sac.

ix. Perfectly clear colourless fluid, containing no albumin, should be carefully examined microscopically for hooklets—it is probably *hydatid* fluid.

2. **To ascertain the effect of the tapping upon the bulk and consistence of the tumour.**—i. If the bulk and consistence are diminished, the fluid has been withdrawn from a closed cavity, as in hydrocele, hæmatocele, and abscess. In cystic disease of the testicle the quantity of fluid withdrawn from any of the cysts may be too small to render the change in the bulk of the tumour evident.

ii. When a very vascular growth is punctured the withdrawal of blood from the blood-vessels causes no diminution in its size. In cases of congenital hydrocele and ascites many pints of fluid may be drawn off through a scrotal puncture, and it will not be until the tension of the fluid in the belly is considerably diminished that the tension of the scrotal swelling will be materially lessened. The quantity of fluid withdrawn establishes the diagnosis.

3. **To permit of a proper examination of the solid parts**

of the tumour.—In cases of syphilitic or tuberculous sarcocele with much effusion into the tunica vaginalis, it is impossible to examine the testicle until the fluid has been drawn off. In cases, too, of malignant disease of the testis there may be a considerable amount of secondary hydrocele, giving rise to fluctuation over the front of the tumour and concealing the surface of the growth.

In some cases **the testicle is painful** without any alteration in its bulk. If it is simply abnormally sensitive, the slightest contact causing pain, the condition is known as **irritable testicle.** This is not infrequent at puberty, and is also met with later in life as the result of masturbation, sexual excess, strong ungratified sexual desire, and debility, and in connexion with hypochondriasis, varicocele, or gonorrhœa.

If the testicle is the seat of paroxysms of pain, dull, or intensely acute, of darting character, usually passing up to the groin and loin, or in the reverse direction, the condition is **neuralgia of the testicle.** In all such cases examine carefully for pyelitis, a renal calculus, renal colic, malaria, injury to the spermatic cord, disease of the lumbar spine, or an abdominal tumour pressing upon the genito-crural nerve.

CHAPTER XLVI

DIAGNOSIS OF INGUINO-SCROTAL SWELLINGS

If, on grasping the root of the scrotum, part of a scrotal swelling is felt between the fingers and the thumb, or if, the tumour being entirely in the scrotum, it can be pushed up into the groin apart from the testicle, it is *inguino-scrotal.*

The commonest and most important of these inguino-scrotal swellings is an inguinal hernia, and therefore the first step in the diagnosis is to determine whether a given swelling is a hernia

If the swelling appeared suddenly at the groin and extended into the scrotum, and is fixed firmly to the deep parts of the belly-wall, or if it is reducible or has been reducible at any time, or if coils of intestine or masses of omentum can be felt, it is a *hernia.* For fuller details of the diagnosis of hernial tumours *see* Chap. XLI.

Having excluded hernia, the surgeon should determine whether the swelling is solid or fluid. To do this, feel for fluctuation. It is often convenient to grasp the tumour in both hands, and then, while gently compressing it with one hand, notice whether the fingers and thumb of the other hand are opened out.

If the tumour is fluid, test for translucency, and remember that a collection of serous fluid may fail to appear translucent owing to the thickness of its coverings or to difficulty in applying the test in the groin. Then notice whether the tumour is reducible or irreducible—and the surgeon must not mistake for reducibility mere mobility of the swelling in the inguinal canal: when a tumour is reduced the inguinal canal should be empty. If it is reducible, feel carefully for a pelvic or abdominal swelling into which the fluid may have been emptied. Similarly examine the effect of coughing, and distinguish between a true impulse filling out or expanding the swelling and a thrust downwards of the tumour. The cord can be fixed by gently drawing upon the testicle; if at the same time the tumour is fixed, it is a sign of its connexion with the spermatic cord.

Fluid inguino-scrotal tumours:

- Hydrocele
  - Congenital.
  - Infantile.
  - Encysted.
  - Of hernial sac.
- Hæmatocele, encysted.
- Abscess.

Gently and continuously compress the tumour, and if it disappears or is reducible into the belly it is a **congenital hydrocele of the cord.** On getting the patient to cough, the tumour will fill out again with a distinct expansile impulse. The flow of fluid along the narrow tube communicating with the peritoneal cavity may be attended with a vibratory thrill. If, on the other hand, the tumour is *suddenly* reduced by pressure, suspect **hydrocele of a hernial sac** with a reducible hernia at the neck. This diagnosis will be confirmed by the history of an old inguinal hernia with a recent considerable increase in the bulk of the tumour, and it will be established if, on reducing the swelling, placing the finger gently on the hernial ring, and getting the patient to stand up, a translucent fluctuating tumour appears, while on gently raising the finger a mass of intestine or omentum is felt to descend from the belly.

If the tumour is quite *irreducible by taxis*, inquire carefully into its history. If there is a history of a hernia on the same side, for which a truss has been worn, and the swelling conceals the spermatic cord, and reaches quite up to the internal abdominal ring, and especially if at its upper end a firmer part is felt, it is a **hydrocele into a hernial sac,** with closure of the neck of the sac by adhesions or by an irreducible knuckle of intestine or piece of omentum. Such a tumour may have a slight impulse on coughing, owing to the compression of the part of it lying in the inguinal canal. The combination of a small *strangulated hernia* with considerable effusion into the sac must be remembered. The ordinary signs of strangulation will be present, and should lead to a correct diagnosis. (*See* p. 596.)

If there is no history of hernia and the tumour extends up to the internal abdominal ring, it is an **infantile hydrocele.** If the tumour is globular or ovoid in shape, tense, smooth in outline, without impulse on coughing, freely movable *with* the cord which it does not conceal, and separate from the testicle, it is an **encysted hydrocele of the cord.** Such cysts may be situated in the inguinal canal, and then are forced downwards on coughing, but the *impulse is not expansile ;* more often they are placed between the external abdominal ring and the testicle. In rare cases there is a narrow, neck-like prolongation to be traced a short distance up the cord above the cyst ; when the tumour is compressed this prolongation fills out, and vice versa.

If as a result of injury or strain an encysted hydrocele has become larger, more tense, painful and tender, and opaque, an **encysted hæmatocele of the cord** may be diagnosed.

If the swelling of the cord is fluctuating, opaque, without impulse on coughing, immovable, irreducible, painful and tender, with the skin over it bulging, reddened, and perhaps œdematous, the part being hot to the touch and the general temperature raised, and the internal abdominal ring is free, the diagnosis of **acute abscess of the cord** should be made.

If the swelling is elongated, rounded, and smooth on the surface, opaque, fluctuating, with a distinct expansile impulse on coughing, reducible into the belly through the inguinal canal but without any gurgle, it is a **pelvic** or **abdominal abscess** which has escaped along the spermatic cord. The abdominal or pelvic part of the abscess will be felt as a rounded, tense swelling with a distinct wave of fluctuation passing between it and the inguino-scrotal swelling. The abscesses which may thus make their exit are psoas abscess, suppuration in connexion with disease of the acetabulum, suppuration of the cellular tissue in front of the bladder, and abscess of the vesicula seminalis spreading up along the vas deferens to the abdominal ring. In the female, abscess may spread from the pelvis along the round ligament. For the diagnosis of these various forms of abscess, *see* p. 665.

Solid inguino-scrotal tumours:

Inflammation of the cord.
Thrombosis of a spermatic vein.
Diffuse hæmatocele of the cord.
Torsion of the testicle.
Lipoma of the cord.
Malignant tumour of the cord.
Diffuse hydrocele of the cord.

1. **Swellings of acute onset.**—If the swelling has come on in a patient with urethritis, and the vas in the whole length of the cord is very painful, tender, and firm, it is **acute inflammation of the spermatic cord.** This spreads so quickly to the epididymis that it is rarely seen as an independent affection.

If a firm, elongated swelling is felt in the cord, distinct from the vas, and especially if it is at all tortuous or irregular in outline, or has come on after an injury or strain, it is a **thrombosis** of one or more of the **spermatic veins.**

If the swelling appeared suddenly after an injury or strain, and was associated with superficial ecchymosis, is irreducible, without impulse on coughing, stationary in size, or gradually or intermittently enlarging, it is a **diffuse hæmatocele of the cord.**

If the swelling appeared suddenly after an injury or strain, and consists of a swollen, very tender testicle with a swollen and tender mass above it formed by the epididymis and cord, and there are acute pain, fever, and vomiting, it is a case of **torsion of the testicle.** This is distinguished from strangulated hernia, for which it may be mistaken, by the greater tenderness of the swelling and by the presence of fever, as well as by the absence of constipation and *regurgitant* vomiting. It is more common in patients who have an imperfectly descended testicle.

2. **Swellings of slow and gradual onset.**—If the tumour is of very slow growth or stationary, lobulated, freely movable under the skin and over the testicle, is loosely fixed to the cord, and if this tumour is irreducible, without impulse on coughing, and opaque, it is a **lipoma of the cord.** This closely resembles an irreducible epiplocele; it is distinguished by the history of the case, if this is obtainable, and especially

if the tumour does not extend so high up as the internal abdominal ring.

If the tumour progressively and rapidly enlarges upwards along the cord, attaining a great size, becomes fixed to the surrounding tissues, and at length to the skin over it, and is attended with enlargement of the iliac and lumbar glands, it is a **malignant tumour of the cord** (*sarcoma* or *carcinoma*).

If the tumour is of small size, elongated, with a rounded contour, soft, pitting slightly upon pressure, it is **œdema or diffuse hydrocele of the cord.** The swelling may have a slight impulse on coughing if it extends up to the internal abdominal ring, or it may fluctuate at its lower part; it is most often seen after wearing a badly fitting truss.

CHAPTER XLVII

DIAGNOSIS OF DISEASES OF THE GROIN

Affections of the Skin

Intertrigo is not uncommon in the fold of the groin of fat, corpulent people. *Mucous patches*, *warts*, and pendulous *fibromata* or *lipomata* may also be met with.

Ulcers of the Groin

The ulcers met with are the primary, glandular, and late venereal ulcers, and those formed by the breaking down of epitheliomatous or other cancerous growths in the inguinal glands. For the diagnosis of chancres, *see* p. 622.

If the ulcer is deep and uneven, with a soft spongy base, livid-red and greatly undermined edge, profuse purulent discharge, and the patient has at the time a chancre on the genitals (or a recent cicatrix left by one), it is an ulcer due to the formation and opening of a **virulent bubo.**

If the ulcer is covered with a black or white slough adherent to the base, and rapidly extends in area and depth, with formation of new sloughs at first white and then black, profuse sero-purulent discharge, livid-red swelling of the skin around, great pain, and severe constitutional disturbance (rapid weak pulse, anorexia, thirst, dry brown tongue, and pyrexia), it is a **sloughing phagedænic chancre.**

If the ulcer is chronic, steadily progressing, with a very irregular base, being at places deeply excavated, at places nodular or fungating, with profuse fetid watery or sanious discharge, and the surrounding tissues are infiltrated and thickened or form a considerable tumour, it is a **malignant ulcer.** This may be a primary growth in the groin, or secondary to malignant disease of the genitals or of the lower limb. The surgeon should examine for a primary growth and for enlargement of the iliac and lumbar glands.

SINUSES IN THE GROIN

The *discharge* should be examined for fæcal matter and urine, and also for organisms, particularly the tubercle bacillus and streptothrix; a probe should be passed to determine the *depth* and *direction* of the sinus; the *neighbouring parts*, especially the spine, pelvis, genitals, and hip-joint, should be examined.

Sinuses may be divided into *superficial* (those not under the deep fascia) and *deep* (those running through the deep fascia).

Superficial sinuses.—If the sinus is covered with thin livid skin, unattended with much induration, and follows upon an acute abscess associated with gonorrhœa, chancre, sore on the heel or foot, it is a sequel to a simple **bubo.**

If the sinus is irregular, multiple, running in a mass of indurated glands in which the individual glands are not to be distinguished, and if it is the sequel to a slow, painless enlargement of these glands with very chronic suppuration, the disease is either **tuberculosis** or **actinomycosis.** (*See* p. 261.)

Deep sinuses:

Artificial anus.
Fæcal fistula.
Urinary fistula.

Dermoid cyst.
Hip disease.
Necrosis of pelvis or femur.
Pericæcal abscess.
Iliac abscess.
Psoas abscess.

Artificial anus is recognized by the fæcal discharge, and by the continuity of the mucous membrane with the skin.

If the discharge contains fæcal matter and flatus, the case is one of **fæcal fistula.** This may follow a strangulated hernia or a penetrating wound; on the right side it may also be the sequel of an appendicular abscess, or tuberculosis or actinomycosis of or around the cæcum.

If the discharge contains urine, proved by the detection of urea, there is a **urinary fistula.** The communication may be with the *bladder*, in which case the escape of urine will be more or less continuous and the probe will pass over the brim of the pelvis. More often the fistula communicates with the *urethra*, in which case there will be other urinary fistulæ in the perineum, the urine will escape only during micturition, and the probe will pass downwards and inwards outside the pelvis to the perineum.

The escape of hair, teeth, fœtal bone, or masses of fatty matter and epithelial débris would indicate a sinus in connexion with a **dermoid cyst.**

If the probe passes towards the acetabulum or along the inner surface of the pelvis and there is evidence of **hip disease,** there will be no difficulty in associating the sinus with the joint disease.

If the sinus passes down into the pelvis of a woman, and a vaginal examination shows considerable induration around the uterus, and especially if the illness followed upon parturition or miscarriage, or gonorrhœa, it is a sinus left from a **pyosalpinx** or other form of **pelvic abscess.**

If the probe strikes bare bone the diagnosis of **necrosis** will be established, and the surgeon must then determine, by the direction and length of the sinus, and especially by a skiagram, where the sequestrum is; if the femur, the sequestrum will move when that bone is moved at the hip-joint.

If the sinus opens above Poupart's ligament (ligamentum inguinale), or below that ligament outside the line of the femoral artery, and extends upwards into the iliac fossa, it is the sequel to an **iliac abscess.** If on the right side, there may be a history pointing to **appendicitis**; if on the left side, to **diverticulitis.** If the sinus leads into an irregular thickened mass, this will be either a tuberculous growth or the result of actinomycosis—a careful examination of the discharge will enable a diagnosis to be made. Both of these diseases are more common on the right side.

If the sinus opens below Poupart's ligament internally to the femoral vessels, and runs up into the belly, it is most probably a sinus left by the opening of a **psoas abscess.**

FLUID TUMOURS OF THE GROIN

Abscess.
Cystic tumour.
Varix.
Aneurysm.
Hydrocele of hernial sac.

Abscess in the groin may be superficial or deep, and in either case may be acute or chronic. (For the diagnosis of chronic abscess from cyst, *see* p. 273.)

When superficial to the deep fascia, and forming a prominent swelling in the groin, covered with more or less acutely inflamed skin, it is a **bubo**, which may be in connexion with the femoral or the inguinal glands, and arise in consequence of a sore on the foot or leg, gonorrhœa, balano-posthitis, or soft chancre. When, in connexion with a soft chancre, a gland becomes acutely inflamed and rapidly runs on to suppuration, and, on being opened, itself shows all the features of a chancre, it is called a *virulent bubo.* Where the inflammation is less intense and the pus forms around the gland, it is spoken of as a *sympathetic bubo;* and when the abscess is more chronic still, fluctuation appearing at several places in a large, ill-defined, boggy swelling, it is probably a *tuberculous* or a *mycotic bubo.*

The deep abscesses are either *femoral* or *pelvic*, and the diagnosis is readily made by noting the position of the swelling, and the presence or absence of fullness, resistance, and fluctuation in the iliac fossa and true pelvis. **Hip disease** is the most frequent cause of femoral abscess, and the surgeon should therefore examine the joint for signs of that disease. When, with signs of hip disease, the swelling occupies the fold of the groin and bulges above that fold, it points particularly to *disease of the acetabulum.*

A fluctuating swelling deep in Scarpa's triangle, associated with limitation of extension of the hip but with free movement of the joint when flexed, tense and globular in outline, is due to *effusion into the ilio-psoas bursa*—a **synovial cyst.**

When less tense, and associated with disease of the adjacent joint, it is an **abscess.** If the swelling is mainly in the belly, along the course of the psoas muscle, and is pointing in the thigh to the inner side of the femoral artery, and there is a wave of fluctuation between the two parts of the swelling, and a distinct impulse in the femoral swelling when the patient coughs, it is a **psoas abscess.** To discover the cause of a psoas abscess, obtain a good skiagram of the spine and the sacro-iliac joint, and examine these parts for caries, and the chest on the same side for fluid in the pleura; examine the urine for pus, albumin, casts, blood, gravel or crystalline deposit, and inquire for a history of attacks of pain shooting from the loin into the groin and testicle. Caries of the spine is the most common cause of psoas abscess; an empyema may burst into the sheath of the muscle and point at the groin, as may also a perinephritic abscess, whether primary or secondary. An abscess from sacro-iliac disease may form in the psoas muscle. In some cases neither of these causes is to be made out, and the suppuration may be ascribed to an injury to the muscle or to a primary psoasitis. A psoas abscess may point in the thigh on the outer side of the femoral artery.

If the abscess fills out the iliac fossa, and projects above Poupart's ligament (ligamentum inguinale) near the iliac crest, with or without a part extending beneath that ligament to the thigh, outside the femoral vessels, it is an **iliac abscess.** If there is a femoral extension of the abscess, it will have an impulse on coughing and will be in part at least reducible. An iliac abscess may be connected with disease of the *sacro-iliac joint* or *spine*, *necrosis of the ilium*, *injury*, *appendicitis*, or *rupture* of part of the *muscle*.

If an abscess pointing in the groin is associated with symptoms of pelvic mischief, a careful examination should be made of that cavity per anum or per vaginam, and where a swelling is found with a wave of fluctuation passing from it to that in the groin, it will be recognized as a **pelvic abscess.** Pelvic cellulitis is much more common in women than in men. These abscesses may point in the inguinal canal and pass into the scrotum or labium.

If the swelling is placed below the fold of the groin internal to the femoral artery, is soft, smooth, and rounded in outline, compressible and easily reducible by direct pressure, without either a slip or a gurgle, it is a **varix of the saphena vein.** Any of the superficial veins of the leg or thigh may be varicose, and it may be easy to trace the internal saphena vein into the swelling. The reducibility of the swelling and its impulse on coughing make it simulate a femoral hernia; its extreme softness and great ease of reduction are characteristic.

A fluid swelling in the inguinal canal of a female, irreducible and extending through the external ring towards the labium, is a **hydrocele of the canal of Nuck.** There may or may not be a history of a previously reducible swelling—a *hernia.*

If there is a history of a femoral hernia, and this has been succeeded by a tense fluctuating swelling in the same situation, without cough-impulse, not reducible, and there is no sign of strangulated hernia, there is a **hydrocele of the sac of a femoral hernia.** This is very closely simulated when a small knuckle of intestine is nipped in the femoral ring, and the sac beyond becomes distended with fluid; there will, however, be signs of intestinal obstruction to guide the surgeon. (*See* Chap. XX.)

A tense fluctuating swelling occupying the inguinal canal and attached to the cord, but without signs of intestinal obstruction, is an **encysted hydrocele of the cord.** (*See* p. 659.)

If the tumour is congenital or first noticed in early life, is soft, lax, irregular in outline, more or less adherent to the surrounding tissues, stationary or slowly enlarging, and perhaps attended with attacks of inflammation from time to time, it is a **cystic hygroma.**

If the tumour is chronic, adherent to the skin, fluctuating, tense, globular in shape, painless and free from tenderness, it is a **sebaceous cyst.**

For the diagnosis of **synovial cyst** beneath the ilio-psoas muscle, *see* p. 354; for that of **pulsating tumours,** *see* Chap. XX.

SOLID TUMOURS OF THE GROIN

The swelling may be a hernia, an imperfectly descended testicle, or a solid enlargement of one or more of the tissues of the part. If there is congenital absence of the testicle from the scrotum, and an ovoid firm tumour of about the size of the testicle is felt in the inguinal or crural canal, or in the iliac fossa close to Poupart's ligament, and especially if the cord can be felt above it, or if pressure upon it causes the peculiar "testicular sensation," it is an **undescended testicle.** If an undescended testicle is not in either of these situations, it may be found in the perineum. The testicle may be fixed, or may slip up and down the inguinal canal and give a thrusting impulse on coughing. Hernia is very often associated with this condition; it is recognized by the presence of a reducible swelling separate from the testicle. A misplaced testicle may be strangulated from rotation, acutely inflamed, complicated with hydrocele, or the seat of malignant disease. The congenital absence of the testicle from the scrotum on the same side, and the attachment of the cord to the testicle, will lead to the diagnosis of the organ affected.

An *inflamed or strangulated retained testicle* may simulate a *strangulated hernia*, and the latter may coexist with an undescended testicle. In orchitis or torsion of the testicle the local pain and tenderness are greater than in hernia ; if there are nausea and vomiting, the latter does not become stercoraceous nor is it urgent, and the constipation is not absolute, while the general symptoms are febrile. The surgeon may find a urethral discharge, or a history of direct violence.

The inguinal and crural canals should be examined for **hernia.** (*See* p. 591.) It is only needful here to refer to *hernia of the ovary* into the inguinal canal (it may pass into the labium), which is recognized by the presence of a small ovoid tumour that swells and becomes painful at each menstrual period, and by the absence of the ovary in the pelvis, as proved by bimanual examination.

A swelling deep under the origin of the adductor muscles, and fixed to the pelvis, may be an **obturator hernia.** (*See* p. 592.)

The lymphatic glands are arranged in two sets in the superficial fascia, one along Poupart's ligament (inguinal), the other along the saphena vein (femoral), and there is a deep gland occupying the crural canal ; by pressure in the iliac fossa the deep inguinal (or iliac) glands, when enlarged, can be felt along the external iliac artery. The position and the outline of the swelling, together with, in most cases, some local cause of infection in the urethra, penis, scrotum, perineum, buttock, groin, or lower limb, or the coexisting enlargement of other groups of glands, will enable the surgeon to diagnose a **glandular swelling.** For the general diagnosis of glandular swellings, *see* p. 263. The following are peculiar to this region :

When many glands are moderately enlarged, firm, quite movable under the skin and over the deep fascia, without pain, tenderness, or other obvious signs of inflammation, they are known as **indolent buboes**; these are met with following hard chancre, and are sometimes spoken of as *amygdaloid*.

When a gland is enlarged, painful, tender, fixed to the skin and deep fascia, and its outline, owing to surrounding œdema, is ill defined, and a source of infection such as a sore on the toe, gonorrhœa, or a soft chancre is found, it is known as a **sympathetic bubo**; the skin over it is hot and reddened, and suppuration is very liable to occur.

Of the remaining tumours in this situation it is only necessary to point out that a hard swelling in the adductor muscles, close to the pubes, chronic and painless, is a "**rider's bone**" or an ossification of the tendon of the adductor longus or magnus muscle. "**Rider's sprain**" may occasion a considerable firm swelling in the adductor muscles, lasting some time after the injury. **Lipoma** and **myxoma** may be met with in the superficial fat, and **enchondroma** or **sarcoma** may be found growing from the pelvic or thigh bones, and the latter also from the fascia and muscular aponeurosis. (*See* Chapters XVIII. and XXIV.) In cases of Charcot's disease of the hip, outgrowths of new bone from the acetabulum may be of sufficient size to form bony swellings in the groin.

CHAPTER XLVIII

DIAGNOSIS OF DISEASES OF THE URINARY ORGANS

In investigating any case of disease of the urinary organs the surgeon should proceed systematically, and should arrange the symptoms and signs of these affections in four classes. He should first investigate the patient's *pain*, then study the *act of micturition*, next examine the *urine passed*, and, lastly, proceed to investigate directly *the urinary passages*, *the bladder*, and *the kidneys*.

Pain is associated with nearly all diseases of the urinary organs. It owns the same causes and has the same general significance here as elsewhere, but the *seat*, *time*, and *character* of the pain are of considerable diagnostic importance. Pain may be either local, i.e. felt at the seat of the lesion, or referred, i.e. felt at a distance from it.

The **referred pains** in urinary cases are recognized by the absence of all other signs of disease at the painful parts, and also by the special seats of these pains. They are experienced at the end of the penis, usually just behind the glans—which is found quite normal—being "referred" there from the neck of the bladder (fundus vesicæ) or pelvis of the kidney; or they are felt in the testicle, groin, and down the thigh, being "referred" to these regions from the kidney, the pelvis of the kidney, and the ureter; this may be associated with retraction of the testicle. These "referred pains" are especially caused by the irritation of calculi and foreign bodies. In *children* the pain "referred" to the end of the urethra is shown by the patient pulling at the penis, often drawing out the foreskin to a considerable length, or by scratching at the vulva. Of the **local pains** it is only necessary to say that pain in the *prostate* is felt in the perineum and rectum, and is excited by the passage of large and hard motions, or by the contact of the finger in the rectum; pain in the *bladder* is felt above the pubes, deep in the perineum, and sometimes in the groins and sacrum; *renal* pain is felt in the loin, passing down to the groin.

When the pain is felt.—The pain may be *spontaneous*, i.e. quite independent of movement on the part of the patient, of micturition, erection, or defæcation; such pain may be due to inflammation, to the contact of foreign bodies and calculi, to the growth of tumours, or to over-distension. Many painful conditions do not give rise to "spontaneous pain."

When pain is *increased during micturition* it shows that either the contraction of the bladder or the passage of the urine along the urethra is painful, and we therefore meet with this symptom in acute cystitis, acute prostatitis, urethritis, stricture of the urethra, chancre or epithelioma of the meatus, and in very tight phimosis.

When pain is *increased at the end of micturition* it shows that the contraction of the bladder down upon its neck is painful, and we therefore meet with this in stone in the bladder, in prostatitis, and in ulceration of the base of the bladder from any cause. A dragging pain in the bladder, felt only at the end of micturition, may be caused by adhesion of the bladder to surrounding structures.

When pain is *diminished after micturition* it points to the contact of the urine with the bladder or the distension of that organ as the cause of the pain, and this we see exemplified in acute cystitis and in retention of urine.

Nearly all pain is *increased by movement*, but where this is a marked symptom it points to the cause of the pain being a movable body, and hence we find this especially in cases of stone in the bladder and in the pelvis of the kidney. Adults are usually able to give clear information on this point at once, as they have noticed the influence upon their sufferings of a railway journey, or of a ride on a rough road, or of coming downstairs. In children the same thing is shown by the patient avoiding rough games or any unnecessary movements, or by crying when made to move, and it may be tested by getting them to jump down from a table or chair; if they do this freely and without any sign of pain, stone free in the bladder may be almost certainly excluded. It is useful to remember that pain from movable kidney or from renal calculus rarely comes on when the patient is at rest, particularly when recumbent, as at night; the pain of movable kidney is relieved by the recumbent position, especially if, in addition, upward pressure is made from the iliac fossa to the false ribs.

When the pain is *increased by defæcation* it shows that the painful part is at the base of the bladder or the prostate. The pain is, of course, more marked when the motions are large and hard.

Erection of the penis causes pain, either by stretching an inflamed urethra, by adding to the congestion of an inflamed prostate, or, when part of the erectile tissue cannot expand, by the great tension to which it is subjected. It is an indication, therefore, of urethritis, of prostatitis, or of an obliteration of part of the corpus spongiosum or corpus cavernosum. When the cause is a stretching of the urethra, a tight pain is felt all along the under-surface of the penis, and the organ is more or less curved down; when it is prostatitis, the erection of the penis is perfect, and the pain is felt deep in the perineum; when it is obliteration of part of the erectile tissue, the penis is sharply bent to one or other side or directly downwards. Painful erection is commonly known as *chordee*, but this term should only be used when the erect penis is bent as well as painful.

Character of the pain.—The pain of acute *inflammation* is described as sharp, pricking, or smarting, while that of chronic inflammation is of a dull aching character; that due to *foreign bodies* or *calculi* is more often spoken of as sharp, cutting, or burning; a straining pain, or "tenesmus," is particularly experienced in *acute cystitis*, in foreign bodies in the bladder, and in retention of urine. When pain becomes throbbing in character it is a useful indication of *suppuration* having occurred. Severe colicky pain in the loin and shooting down to the groin and testicle attends the impaction or passage of a *calculus in the ureter* and *acute hydronephrosis*.

The act of micturition.—In health, when the urine has distended the bladder to a certain extent, a stimulus is transmitted to a centre in the lumbar enlargement of the spinal cord and there reflected along motor nerves to the muscular coat of the bladder, and at the same time the contraction of the sphincter muscles is inhibited. This reflex centre is under the control of the will, and the act can be excited or inhibited by the will, which also can increase the expelling force by throwing into contraction the abdominal muscles. The resistance to be overcome is that offered by the urethra, and the shape of the issuing stream is determined by the meatus urinarius. A knowledge of these facts enables us to understand how the act may be modified.

Nearly all the affections of the urinary organs cause **frequency of micturition.** This may be due to *increased stimulation* of the bladder by abnormal urine or by calculi and foreign bodies; by *undue irritability* of the bladder, as in all forms of cystitis and prostatitis; by a *small size* of the bladder, so that a few ounces of urine distend it; by *failure to empty* the bladder, when, as in the last case, the addition of a small quantity of urine to that retained in the bladder distends it to the full; by *irritation of other parts* of the urinary apparatus, as in renal calculus, pyelitis, acute distension of the pelvis of the kidney, urethritis, and phimosis; by *instability of the centre* in the spinal cord, whereby it responds to stimuli of too feeble force—this is seen in the nocturnal "incontinence" of children, and in the effects of sexual excess; and, lastly, by *stimuli from the brain*, as in some cases of hysteria and some forms of "nervousness." The frequency due to the irritation of calculi and foreign bodies is increased by movement; that due to chronic enlargement of the prostate is more marked at night.

Unconscious micturition.—Micturition should be a conscious act; it may be *unconscious*, through an *interruption in the path of sensation* in the cord, or through the reflex centre responding to a *stimulus not powerful enough to excite sensation*, as is seen in the nocturnal "incontinence" of children; or by the *bladder leaking*, as occurs in cases of great overdistension from atony, when the sphincter action is interfered with and urine leaks or dribbles out into the urethra; this leaking must be distinguished from the expulsive act of micturition. *Unconscious micturition* is often spoken of as "involuntary." The surgeon must not mistake frequency of micturition or unconscious micturition for "incontinence of urine," a condition only met with in extroversion of the bladder, in large recto-vesical or vesico-vaginal fistula, and in paralysis.

The **force of the stream** depends upon the expelling power of the bladder and abdominal muscles, and the obstruction offered by the urethra; this force is estimated by the distance to which the stream can be propelled from the body: it may be *increased* by very powerful contraction of the bladder, as is sometimes seen in vesical calculus; it is *diminished* by atony of the bladder, hypertrophy of the prostate, or tight stricture.

The **size and shape of the stream** depend upon conditions in the urethra. When there is stricture the stream may not fully distend the meatus, and then will not be shaped by it, but will be twisted or bifid. The stream may be reduced to a mere succession of drops.

The **duration of micturition** is increased by stricture, by atony of the bladder, and by enlargement of the prostate. Patients often complain of a difficulty in beginning to pass water: this may be owing to an interference with the nervous mechanism, and it is a very frequent symptom of prostatic enlargement; a similar difficulty in "leaving off," or a dribbling continuing after the close of the voluntary act, is seen in cases of enlarged prostate with atony of the bladder and "residual" urine, and in advanced cases of urethral stricture. A *sudden interruption* of the act is a rare symptom caused by a stone or a growth in the bladder blocking up the neck.

The escape of urine from other orifices than that of the urethra is evidence of **urinary fistula**, which will be named according to its position, viz. perineal, scrotal, rectal, vaginal, etc.

Retention of urine is a condition characterized by inability to empty the bladder. It may be *complete* or *partial*, and as the latter is often associated with involuntary or frequent micturition it is overlooked by the patients, and may be mistaken by the surgeon unless he remembers that in the great majority of cases *dribbling arises from overflow.*

Complete retention has to be distinguished from suppression, ruptured bladder, and extravasation of urine. It is characterized by the presence of a full bladder, as felt per rectum and above the pubes, and usually by a painful desire to pass water, while the introduction of a catheter is followed by the escape of a large quantity of urine, relief of the pain, and disappearance of the bladder tumour. In the other conditions there is no bladder tumour, and, on passing a catheter into the bladder, either no urine or only a small quantity of bloody urine is drawn off. In *suppression of urine* the bladder is empty, there is no swelling from the escape of urine, and after a time there are characteristic general signs, such as coma and convulsions; in *rupture of the bladder* there is a history of an accident, or of long previous retention with a sense of sudden yielding; and in *extravasation of urine* there is the characteristic swelling in the perineum, scrotum, penis, and abdominal wall. (*See* p. 632.)

Partial retention is characterized by frequency of micturition, by loss of force in the stream, and often by dribbling of urine or inability to prevent the escape of a few drops of urine during coughing or effort. These symptoms are worse at night; after the patient has tried to empty his bladder, the catheter draws off the residual urine.

The **causes of retention** are nervous, muscular, or obstructive. *Nervous retention* is caused by inhibition of the micturition centre by some strong stimulus, such as that caused by an operation on the rectum or urinary organs, or even by any injury or operation, by severe pain in the act of micturition, as in acute urethritis, and also by hysteria and "nervousness." The retention sometimes seen in acute over-distension may be due to exhaustion of the lumbar centre. Compression of the brain and contusion of the cervical and dorsal spinal cord are other causes of "nervous" retention. This form of retention is characterized by its suddenness, its completeness, its evident relation in most cases to an injury or operation, and by the absence of all "obstruction."

Muscular retention is due to over-distension of the bladder paralysing the muscle, to atony of the bladder, and perhaps to prostatic growths interfering with the action of the muscle. It is characterized by being chronic (except in cases of acute distension), generally partial, or attended with "dribbling," and by the feeble power with which the urine flows from a catheter; indeed, the bladder may be quite unable to expel its contents, and the surgeon may have to force out the urine by pressure above the pubes.

Obstructive retention may be *traumatic* or *idiopathic*. Fracture of the pelvis, subpubic dislocation of the hip, and rupture of the urethra are the injuries leading to it. The idiopathic causes are calculi and foreign bodies blocking the passage, inflammatory swelling or stricture of the wall of the urethra, and tumours pressing upon and blocking up the passage. The obstruction from calculi, etc., is sudden; from inflammation it is acute and attended with other obvious signs, such as pain, swelling, and discharge; from stricture or tumour it is chronic, and is preceded by difficulty in micturition or diminution in the force or size of the stream. The history of the case and the age of the patient usually suffice to enable the surgeon to diagnose the case; the previous occurrence of urethral discharge, or of a small or feeble stream, of pain after micturition, or renal colic, or the operation of lithotrity, is to be inquired for. In children, retention is most often due to impaction of a calculus; in young men, to urethritis, prostatitis, or abscess; in middle-aged men, to stricture; and in elderly men, to hypertrophy of the prostate or to stone.

Examination of the urine.—An examination of the urine in disease of the kidneys or urinary passages should afford an answer to two questions—(1) Are the kidneys discharging their excretory functions properly? (2) Are any abnormal substances added to the urine? The first question can, as a rule, be answered by determining the total daily excretion, its specific gravity, reaction, colour, and the amount of urea it contains. In some cases, in addition, it is of importance to estimate the amount of urea in the blood. To answer the second question, test for the presence of albumin, blood, pus, and sugar; search for tube-casts; examine microscopically any deposit present, and examine the urine for organisms.

Albuminuria may be due to the admixture of blood or pus with the urine, or to some condition of the kidneys, their blood-vessels, or the blood, leading to a filtration of blood-serum. Wherever albuminuria is unattended with the presence of blood- or pus-cells in the urine, it is due to some fault in the renal excretion; this diagnosis is corroborated if "tube-casts" of any kind are found. And where the amount of albumin is out of proportion to the number of blood- or pus-cells seen, the same inference is to be drawn.

Hæmaturia is most certainly shown by the detection of blood-corpuscles in the urine. The surgeon must then decide the *source of the blood*, whether urethral, vesical, or renal. If the blood escapes involuntarily and independently of the act of micturition, or passes with the first few drops of urine only, or if the escape of urine is preceded by the passage of a long clot the size and shape of the urethra, the blood is *urethral.* The most common causes of urethral hæmorrhage are injury and catheterism.

When the blood flows only with the last drops of urine, it certainly comes from the *prostate* or *neck of the bladder*, and its cause will be inflammation or congestion of the prostate, or calculus. The history of the case, particularly the existence of urethritis or of stricture, the examination of the prostate or the passage of a sound, will decide the diagnosis.

In extensive bleeding from the *prostate* the blood flows back into the bladder, and it is not then to be distinguished from vesical hæmorrhage except by other signs of prostatic disease. When the blood is not intimately mixed with the urine, but becomes more abundant towards the end of the act, or when the urine contains flat or irregular-shaped clots, or is reddish in colour, it is from the *prostate* or *bladder.*

The causes of *vesical hæmorrhage* are stone in the bladder, vesical tumours, acute cystitis, tuberculous and cancerous ulceration of the bladder, schistosomiasis (bilharziosis), rupture of a vesical varix, and perhaps hæmophilia, purpura, and scurvy. The hæmorrhage from *stone* is often small in amount, intermittent, especially excited by exercise, and accompanied by the characteristic pain, etc. Hæmorrhage from *villous tumour* comes on suddenly without obvious cause, is often exceedingly profuse, and after continuing for a while ceases equally abruptly and may not recur for a long time. In some cases the bleeding occurs during the act of micturition, and as the urine is passed it becomes more and more bloody until at last pure blood flows when the bladder is compressing the very vascular growth. In *malignant tumour of the bladder* the hæmorrhage is more frequent but less abundant, and pain, frequency of micturition, and cachexia are marked. The hæmorrhage of *acute cystitis* is moderate in amount and accompanied by intense pain and frequency of micturition, and the urine contains mucus and pus. In *tuberculous ulceration* the blood is small in amount and mixed with pus, and there may be signs of tubercle in the kidney, prostate, testicle, or vesiculæ seminales. The tubercle bacillus must be sought in the urine—it is not easily found. The hæmorrhage due to the *schistosoma* is usually slight in amount and frequently recurring; the ova of the parasite are found in the urine. *Vesical varix* is a very rare condition characterized by occasional profuse hæmorrhages, and is only to be diagnosed when the varix is seen through the cystoscope. Other signs of *purpura*, *scurvy*, and *hæmophilia* accompany bleeding from these causes.

Where the blood is intimately mixed with the urine, or the urine has a smoky tint, or there are long narrow clots ("casts" of the ureter), it is certainly *renal* in origin. The cystoscope must be used to determine whether the bleeding is from one or both kidneys. Very profuse renal or prostatic hæmorrhage may closely simulate vesical hæmorrhage, and is only to be distinguished by other signs of disease of these organs.

Renal hæmorrhage may be due to injury, acute inflammation, infarction, stone, tubercle, growths, parasites, or blood changes. The history of the case decides whether it is due to *injury*. When due to *inflammation* it is accompanied by excess of albumin, by tube casts, and is usually associated with œdema and other signs of blood change. Hæmorrhage due to *stone* is chiefly characterized by its being increased by exercise or movement, by the pain, and sometimes by the passage of gravel. Hæmorrhage due to *tubercle* is recognized by the detection of tubercle bacilli in the urine, by the presence of tuberculous disease elsewhere, by fever, and by the admixture of pus with the blood; the hæmorrhage is usually slight. The hæmorrhage of *renal tumour* may be very profuse or very slight; in papilloma of the pelvis it is profuse as in the similar disease of the bladder, and there are abundant epithelial cells in the urine; there may be no renal tumour to be felt, and in any case the palpable swelling is but slight. The signs of *hæmophilia*, *scurvy*, *purpura*, *fever*, and the causes of *renal congestion* are so apparent that the diagnosis of hæmorrhage from these sources is easy. Hæmorrhage as a part of *chyluria* is recognized by the fibrinous coagula, the milky colour due to fat, and possibly by the detection of filariæ in the blood.

In all cases of hæmaturia, in which neither the history, e.g. of an injury, nor the result of a simple physical examination, e.g. the detection of an enlarged prostate, nor a renal tumour, renders the cause of the bleeding obvious, a cystoscopic examination must be made at the earliest possible moment.

If postponed until the bleeding has ceased, the diagnosis may be rendered more difficult.

Pyuria.—Pus is a frequent addition to urine, and is recognized by turbidity of the urine, by the presence of albumin and pus cells, and, when the pus deposits in quantity, by the fact that liquor potassæ converts this deposit into a very ropy, tenacious fluid. The addition of ozonic ether to purulent urine causes free and continued effervescence. If the pus escapes from the penis independently of micturition, it is *urethral*, due either to *urethritis* or to *abscess* opening into the urethra. A sudden discharge of pus in the urine indicates the bursting of an *abscess*, the seat of which will be shown by swelling and pain; if the act of micturition ends in the passage of a small quantity of pus, it points to suppuration in the *prostate*. The passage of very ropy *muco-pus* in alkaline, foul-smelling urine shows that there is *cystitis*. Pus in large quantity in acid urine is derived from the pelvis of the *kidney*, or more rarely from an abscess opening into the bladder or ureter. B.-coli *bacilluria* may be recognized by the characteristic opalescence of acid urine; the bacillus, like other organisms, must be identified by bacteriological methods.

The *mucus* of urine is increased in inflammation of any part of the urinary tract. *Semen* may be found in urine, especially after a seminal emission. The passage of *flatus* or of *fæcal* matter, the latter recognized by the animal and vegetable fibres and cells as well as by its colour, consistence, and odour, shows that there is a communication between the alimentary canal and the bladder; this condition is usually attended with extreme pain, and it generally leads on to cystitis. The surgeon must endeavour to determine what part of the intestine opens into the bladder by the amount, the colour, and the consistence of the fæcal matter, or by the rapidity with which such a substance as charcoal given by the mouth is recognized in the urine. The communication may be a congenital malformation, but it is more often due to cancerous ulceration, to typhoid ulceration, or to pelvic abscess; the history of the case clears up the diagnosis. As a sequel to an attack of appendicitis the appendix may form a communication with the bladder, and intermittently—perhaps at very long intervals—discharge a small amount of fæcal matter into the bladder. For the diagnostic significance of *bile* or *sugar* in the urine, and of the various *crystalline deposits*, the reader must refer to other works. The passage of *hair* or of masses of sebaceous matter indicates the opening of a *dermoid cyst* into some part of the urinary apparatus. *Echinococcus hooklets* and *hydatid vesicles* have been found in the urine.

Examination of the urethra.—For malformations of the urethra, *see* Chap. XLIII.

The size and condition of the **orifice**, and the presence of **discharge**, if any, are to be noticed. The orifice may be too small (*stricture*). A cyst or a wart may project from it, or its edges may be the seat of *chancre* or of *epithelioma*. Should the orifice be swollen and covered with a gummy discharge, and be the seat of itching, and these signs have appeared two to seven days after coitus, it is the *initial stage of acute urethritis*. If there is an abundant thick yellow or greenish discharge, and the penis is swollen, and the urethra feels firm and tender, there is *acute urethritis*; when the discharge becomes milky in colour, and the pain and swelling subside, it is *chronic urethritis*; and if the discharge consists only of shreds voided in the first portion of the urine, or of a drop of gummy discharge at the meatus, seen perhaps only in the morning, it is *gleet*. In all these cases the gonococcus must be sought for in the discharge. If the discharge is sanious, and an ulcer is seen just within the orifice, it is a *soft chancre*. A sero-purulent discharge with little or no pain, associated with a firm lump in the urethra near the orifice, and multiple enlargement of the inguinal glands, and followed by sore throat and a rash, is due to a *hard chancre*. *Gonorrhœa* is distinguished from other forms of urethritis by the presence of the gonococcus in the discharge. A painless muco-purulent discharge is sometimes seen in secondary *syphilis*. *Gouty urethritis* is to be distinguished by the history and concomitant affections and by the absenee of the gonococcus. *Gleet* may be caused by chronic urethritis or prostatitis, by a stricture, or by a urinary fistula.

Now let the surgeon pass his fingers back along the urethra to the perineum: it may be swollen and tender in acute urethritis, or hard and knotty in severe stricture; if a painful and tender, ill-defined firm swelling is felt in the anterior perineum, it is a **perineal abscess**; in its later stages fluctuation may be felt. A similar swelling with much surrounding œdema may be found over the urethra where it is covered by the scrotum, the pus being under the ejaculator urinæ muscle; such an abscess will point at the root of the penis.

An examination of the urethra with the urethroscope enables the surgeon to note the presence and exact position of granulations, ulcers, erosions, distended follicles, and of hyperæmia of the mucous membrane, and so to determine the site and character of the lesion responsible for the persistence of a chronic urethritis.

If a young or middle-aged man complains of difficulty in micturition, with loss of force of the stream, forking of the stream, or dribbling at the end of micturition, or of retention, and there is a history of a previous attack of gonorrhœa or of injury, there is probably a **stricture of the urethra.** This may be due to *spasm* of the extrinsic muscles of the urethra, *congestion* of the mucous membrane, or *organic* narrowing of its lumen. Any two of these causes may be present together. Pure spasmodic stricture is rare ; cases of retention of urine after rectal or perineal operations are said to be due to this condition. The more probable cause is inhibition of the bladder. *Congestive stricture* may be diagnosed if a patient during the early stage of gonorrhœa is suddenly seized with retention, and examination of the prostate is negative. It is unnecessary and bad practice to pass a catheter or bougie in this case. *Organic stricture* may be suspected if the patient gives a history of gonorrhœa some years previously, or of injury to the perineum, and of progressive difficulty in passing urine, characterized by having to strain to commence the act, and also by enfeeblement and distortion of the stream, culminating perhaps in retention or dribbling of urine, the accompanying retention being unrecognized by the patient. The diagnosis is confirmed by passing a catheter or bougie and demonstrating an actual narrowing of the urethra.

An attempt should first be made to pass a full-sized instrument. If obstruction is encountered within 6 in. of the meatus a stricture is present. The surgeon has to determine the position, size, and number of the narrowings. This examination is best made with "acorn" or "bullet-headed" instruments, successively smaller sizes being used until the largest is found which can be passed through the stricture or strictures into the bladder.

If in passing a catheter a coarse grating is felt, it shows that there is a **urethral** or **prostatic calculus,** and the exact position at which the grating occurs, as measured by the stem of the catheter, distinguishes between these two. The soft grating felt in passing an instrument through an old tough stricture must not be mistaken for a calculus. If, as the catheter is passed, a sudden flow of pus occurs, it shows that a **periurethral abscess** has been opened; these are most commonly prostatic, but the position of the abscess is easily ascertained by the detection of swelling. If on passing a catheter the shaft is found to deviate from the middle line, or the instrument passes in to its full length without reaching the bladder (except in cases of prostatic hypertrophy), pass the finger into the rectum, and if the catheter is felt to be very superficial, or to one or other side of the middle line, it has entered a **false passage.** If, when the surgeon is trying to overcome an obstruction, the catheter suddenly slips on with a soft grating sensation, and blood escapes, he knows that he has made a false passage; an instrument is never grasped by a false passage as it is by a stricture or by the compressor urethræ muscle.

Examination of the prostate.—The condition of the prostate can be investigated (*a*) by digital examination with the finger in the rectum, (*b*) by the passage of catheters or bougies, (*c*) by the cystoscope, and (*d*) by the X-rays. The facts to be noted are its size, shape, and consistence, its mobility in the pelvis, its tenderness, and its opacity to X-rays. The following affections of the prostate can be diagnosed:

Acute prostatitis is diagnosed if a patient who has or has recently had acute urethritis complains of deep-seated perineal pain, and a finger in the rectum finds the prostate to be uniformly enlarged, hot, and tender. If in a similar case the swelling of the prostate is soft and fluctuating, there is a *prostatic abscess.* Retention of urine may occur in either of these conditions. Acute prostatitis may also follow clumsy instrumentation.

Chronic prostatitis is a common cause of gleet. It is to be diagnosed if in a patient with a chronic urethral discharge the prostate is felt to be slightly enlarged, and massage of the gland with the finger in the rectum causes a diminution in size, and the first few ounces of urine passed immediately after contain flakes of discharge from the prostatic crypts.

Prostatic calculi rarely give rise to marked symptoms. The diagnosis is usually made either by their being felt by the finger in the rectum or by the characteristic grating on passing a catheter. Their presence can be shown by the X-rays.

Chronic enlargement of the prostate.—If a patient over 50 years of age complains of difficulty of micturition, delay in starting the act, and of frequency more marked by night than during the day, and the passage of a catheter, other than a large coudé, is difficult and reveals increase in length of the urethra, and the presence of more or less residual urine, chronic enlargement of the prostate is to be suspected. The diagnosis is confirmed if the prostate is felt to be definitely enlarged, or if the cystoscope reveals a projection into the bladder just behind the internal meatus. If the enlarged gland has a smooth surface and is movable in the pelvis, it is an *adenomatous* or *simple enlargement.* If, on the other hand, the prostate is very firm, irregular, and nodular, and the lateral limits of the gland are ill defined and it is fixed, the enlargement is due to *carcinoma of the prostate.*

One or more of the following complications of enlarged prostate are commonly present, and their symptoms are then added to those enumerated above, viz. hæmaturia, cystitis, retention, and vesical calculus. It is to be noted that hæmaturia occurs earlier and is more profuse in simple than in malignant enlargement of the gland.

Examination of the bladder.—In addition to the ordinary methods of examination by palpation, percussion, etc., the condition of the bladder may be investigated by the passage of instruments, especially the sound, by the X-rays and the cystoscope. The proper use of this latter instrument is attended by no risk to the patient, and the information it is capable of yielding is so important that its use should be a routine measure in the diagnosis of vesical and also of renal affections.

The following affections of the bladder may be met with:

Ectopia vesicæ is a congenital abnormality characterized by failure of development of the anterior vesical wall, and separation of the pubic bones. The bladder appears as a raw red surface discharging mucus, on which the two ureteric orifices are to be seen dribbling urine. The external genitals are always grossly abnormal.

Sacculus of the bladder may be a congenital condition or may be acquired secondarily to stricture of the urethra or other condition. It may be found in a hernial sac, or appear as a dull cystic swelling above the pubes, not altered when the bladder is emptied by a catheter, but discharging urine by the catheter when pressure is made on it; or it may be seen in a cystoscopic examination. In cases of doubt the bladder should be filled with collargol or sodium bromide solution and then examined with the X-rays.

Acute cystitis is diagnosed when the urine contains pus and mucus, is alkaline in reaction, and there is marked frequency. The patient complains of pain above the pubes and deep in the perineum. The pain is sometimes agonizing and accompanied by severe strangury. A cystoscopic examination should not be made in this condition, but the urine should be examined bacteriologically and the cause of the condition determined. There may be a history of passage of instruments or of disease of other parts of the urinary tract. The absence of organisms in a smear made from the purulent sediment of the urine, strongly suggests a tuberculous condition, and it is not uncommon for the initial infection of the bladder with tubercle bacilli to show itself as an acute cystitis.

If the patient is acutely ill, and the urine in addition contains shreds of bladder mucous membrane in quantities of pus, the condition is **membranous cystitis.**

Chronic cystitis is characterized by moderate frequency, and an alkaline urine with some pus and mucus; it usually occurs as a sequel to calculus, stricture, catheterism, growths in the bladder, or enlarged prostate. A complete diagnosis involves the recognition of the primary trouble, and also of the organisms present in the urine. A special form of chronic cystitis is *tuberculous cystitis*; this is almost invariably secondary to tuberculous disease of the kidney or genital tract. It is to be suspected in such cases if there is frequency accompanied by tubercle bacilli in the urine. The detection of these organisms is difficult, and may only be accomplished by inoculating a guinea-pig and awaiting the de-

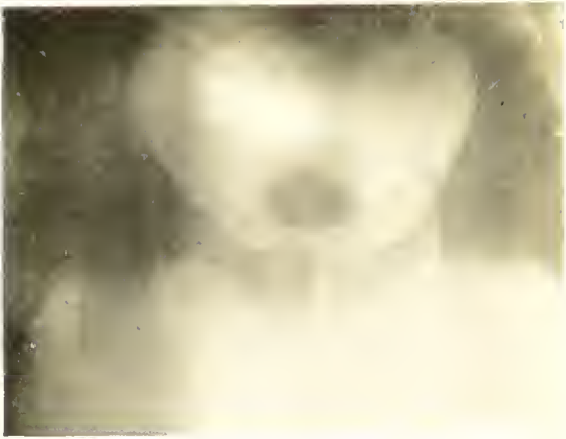


Fig. 1.—Calculus in bladder (p. 693).

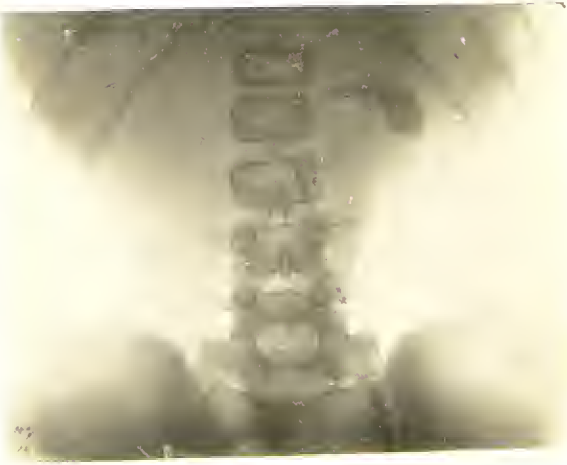


Fig. 2.—Calculus in kidney (p. 695).

PLATE XVII.

velopment of tuberculous lesions. The diagnosis is confirmed by the cystoscope. This examination reveals, according to the stage of disease of the bladder, either (*a*) localized patches of injection of the mucous membrane in the neighbourhood of the ureteric orifices, (*b*) scattered grey tubercles in the same region, or (*c*) definite ulcers with ragged edges possibly involving the orifices themselves. The bladder in these latter cases is extremely irritable, there is great pain preceding micturition, and the capacity of the bladder is greatly reduced.

Vesical calculus is to be suspected if the patient complains of pain felt above the pubes or referred to the end of the penis, the pain being greatest towards the end of micturition, exaggerated by exercise and relieved by rest, and if in addition there is frequency most marked during the day, with a history of occasional slight hæmaturia. In rare cases the patient may have noticed that in passing water the stream is suddenly checked, starting again after some change of position.

The diagnosis can be confirmed (*a*) by a skiagram (Plate XVII., Fig. 1), which shows the number and approximate size of the stones if present—pure uric-acid calculi cast no shadow with the X-rays; (*b*) by the use of the sound, and (*c*) by the cystoscope. In using a sound, care must be taken to ensure that the sound is in the bladder and that every part of the bladder is explored. The resistance of a tumour or of the bones of the pelvis, or the soft grating of phosphatic deposits on the bladder-walls, must not be mistaken for the audible "click" of the sound against a stone. On the other hand, a stone which is covered with a thick deposit of mucus may not give a "click," and if in a sacculus a stone may be missed by the sound.

The cystoscope enables one to explore the whole bladder and to determine not only the presence of a calculus, but also its position, whether free or in a sacculus, the number and size, the probable composition, and also the state of the bladder-wall—points which all have an important bearing upon treatment.

An examination of the urine in cases of stone is of importance chiefly as showing the degree of cystitis present and the functional activity of the kidneys. The surface of the stone will be formed of the salts least soluble in the urine. Where, as frequently happens, this has varied from time to time, the stone will be a mixed one with concentric layers of different composition.

Tumours of the bladder first show their presence by hæmaturia, and the first step in the diagnosis, therefore, is to determine that the hæmaturia is of vesical origin. In the case of simple tumour of the bladder, i.e. villous papilloma, the hæmaturia is painless and profuse, lasting a few days and recurring after a varying interval. The patient is usually young or middle-aged. The diagnosis is confirmed by finding portions of the growth in the urine and by the cystoscope. When tumour is complicated by cystitis, pain and frequency occur. In addition to detecting the presence of the growth, a cystoscopic examination should determine whether it is pedunculated or sessile, and how large an area of the bladder mucosa is involved. In malignant tumour of the bladder, i.e. carcinoma, the patient is usually past middle life, the hæmaturia is more constant and less profuse, and pain, exaggerated by micturition, appears sooner or later. The tumour may be felt from the rectum or bimanually. The cystoscope reveals a fungating ulcerated mass covered with shreds of mucus and possibly phosphatic concretions, an appearance that is closely simulated by some cases of œdematous cystitis. Malignant tumours of the bladder are always complicated by cystitis, and sometimes by retention, stone, and recto-vesical fistula.

Fistula of the bladder.—As a result of the ulceration of a tumour of the rectum or bladder, or typhoid ulceration of intestine, or local peritonitis, e.g. appendicitis, and rarely as a consequence of œdematous softening of the bladder-wall in cystitis, a communication may be formed between the bladder and the intestinal canal. This is shown by the passage of fæcal matter and flatus per urethram. With the cystoscope the position and size of the opening in the bladder may be seen.

Examination of the kidneys.—Besides examination of the kidneys by palpation, percussion, and examining the urine, three special methods are available in the diagnosis of renal affections. The X-rays are used to determine the presence of calculi in the kidneys (Plate XVII., Fig. 2) and ureters, and also, after the injection into the renal pelvis of collargol or sodium bromide, both of which in 10 per cent. solution are opaque to the X-rays, to map out the position and shape of the pelvis, calyces, and ureters. This latter method of examination is known as pyelography. The cystoscope is used to examine the ureteric orifices, and also to enable ureteric catheters to be passed through which the renal pelvis is injected or separate specimens of urine are collected from each kidney. This segregation serves the twofold purpose of allowing the surgeon to detect abnormal constituents in one or other specimen, and to compare the functional capacity of the two kidneys.

The **functional activity** of **one** or **both kidneys** may be tested by any of the following methods: 1. By estimating the amount of urea excreted by each kidney in a given time. This is best done by estimating the urea content of specimens collected one and two hours respectively after the ingestion of 15 grm. of urea—the urea-concentration test. If the renal function as a whole is in question, this test should be combined with an estimation of the blood-urea. 2. By determining the time of the first appearance of sugar in the urine, and the total amount of it passed in two hours after the subcutaneous injection of 5 mg. of phloridzin. 3. If a solution containing 6 mg. of phenol-sulphone-phthalein is injected either into the buttock or into a vein, the time of its first appearance in the urine and its maximum excretion can be noted colorimetrically.

To examine the kidney, one hand should be placed under the loin and the other in front, and the patient should then breathe deeply and regularly. By this means its *size*, its *shape*, its *mobility*, its *consistence*, and any unusual *tenderness* of the organ can be appreciated.

The following surgical conditions of the kidney and ureter may be met with :

Hydronephrosis.
Pyonephrosis.
Calculus.
Pyelitis.
Tuberculous nephritis.
Suppurative pyelonephritis.
Tumours (including movable kidney).

Hydronephrosis (Plate XIX., Fig. 1).—Distension of the pelvis and calyces follows partial obstruction to the passage of urine from the kidney to the exterior. If the obstruction be above the bladder, unilateral hydronephrosis rapidly results; if it be at the neck of the bladder or in the urethra, the distension does

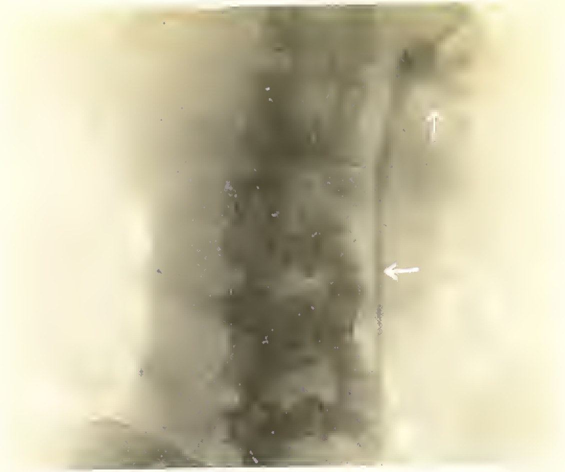


Fig. 1.—Pyelogram: Normal kidney.

The arrows point to catheter in ureter, to open angle between this and lower calyx and to upper and lower calyces.

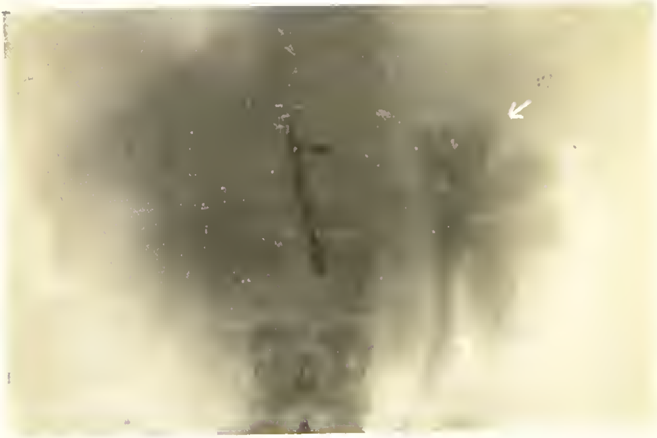


Fig. 2.—Pyelogram: Dilated calyces.

PLATE XVIII.

(Thomson-Walker's "Genito-Urinary Surgery.")

not occur until the hypertrophy of the bladder-wall impedes the flow of urine through the ureteric orifices; it is then always bilateral. It is clear that numerous conditions may give rise to hydronephrosis. Abnormal implantation of the ureter into the pelvis, calculus in the pelvis or ureter, a growth in the pelvis, kinking of the ureter when the kidney is movable, cicatrization of the ureter after trauma, or compression of the ureter by an abnormal branch of the renal artery will produce *unilateral hydronephrosis;* whilst enlarged prostate, stone in the bladder, stricture of the urethra, phimosis, malignant disease of bladder or prostate will produce *bilateral hydronephrosis.* A malignant tumour of the cervix uteri infiltrating the cellular tissue at the neck of the bladder may obstruct one or both ureters.

The diagnosis of hydronephrosis depends upon the recognition of the presence in one or both loins of a *fluid renal* tumour. The cause of the condition may be clear from the history of the case, or complete examination of the urinary tract may reveal one of the causative affections mentioned above. An important diagnostic feature, when present, is the variable size of the tumour, diminution in size being accompanied by a copious flow of urine. The patient himself may be conscious of the alteration in size from time to time. "Intermittent hydronephrosis," as this condition is termed, occurs particularly in movable kidney or when an aberrant artery crosses and presses upon the ureter. The diagnosis may be confirmed by pyelography, the skiagram showing distension of the renal pelvis with greater or lesser absorption of the distended calyces into a common cavity. (Plate XVIII.) In cases of aberrant artery the pyelogram is characteristic—the renal pelvis, however distended, passing down into a conical stalk, with its apex at the point of obstruction. From pyonephrosis the diagnosis is only made by the absence of constitutional signs and symptoms and finally by the withdrawal of urine free from pus from the affected kidney.

When the urine is primarily infected with organisms and there is partial obstruction to its outflow, **pyonephrosis** and not hydronephrosis results. The presence of pus in the distended kidney is to be suspected if the patient shows signs of chronic septic absorption, such as rigors, fever, local pain and tenderness, anæmia, wasting, and leucocytosis. This general state is simulated by the renal insufficiency accompanying advanced destruction of kidney tissue. The withdrawal or passage of purulent urine from the affected side confirms the diagnosis of pyonephrosis.

Renal calculus.—The diagnosis of stone in the kidney is made by a consideration of the history and by examination of the urine and of the kidney region with the hand and the X-rays. In the history *pain* is the cardinal symptom. The patient may complain of either a dull gnawing pain felt in the back at one or other side of the lumbar spine, relieved by rest and aggravated by exercise, persisting unchanged for months or even years; or of attacks of very severe pain known as renal colic. These attacks are often brought on by exercise or a sudden movement; the pain, of an intense, sickening character, starts suddenly, is felt in the loin but shoots down the groin to the testicle of the affected side, which is sometimes drawn up to the external abdominal ring. Vomiting occurs and is accompanied by sweating and faintness, the patient writhing in agony. After a variable time the pain ceases as suddenly as it began. Following such attacks, but also independently of them, there may occur hæmaturia.

One case may exhibit either one or both of these forms of pain, whilst in a small number no pain is complained of. In such cases the only symptoms will be slight recurring hæmaturia and a small degree of frequency by day. Albumin, pus, and blood may be found in the urine, and crystals of oxalate of lime, or of uric acid or urates.

When the affected kidney region is examined by the surgeon he will find *tenderness.* Renal tenderness is best elicited by introducing the tips of two fingers deeply in an upward direction below the tip of the last rib, while the other hand supports the loin behind, and then instructing the patient to take a deep breath. Should hydronephrosis or pyonephrosis have occurred, the kidney will be felt enlarged. Examination of the segregated urine will reveal pus in an acid urine; hæmaturia varying in amount, usually slight and often only detected by finding red blood-cells under the microscope; and crystals either of calcium oxalate, urates, or uric acid, according to the composition of the stone.

A good skiagram, taken with precautions as to emptying of the colon, etc., will reveal the presence, position, number, and approximate size of any stones present, with the exception of pure uric-acid stones, which, as already mentioned, do not throw a shadow. Pyelography can be used to determine the relation of any doubtful shadow to the kidney. Difficulties in diagnosis arise from the occasional absence of all symptoms, or from their being referred to the unaffected side, from the absence of any change in the urine, and from a negative skiagram in cases of uric-acid stones. The differential diagnosis is from cases of oxaluria, where the pain exactly resembles renal colic but the urine is loaded with oxalate crystals and red blood-cells, from tuberculous disease of the kidney; and from Dietl's crises occurring with a movable kidney. On the right side the condition is sometimes mistaken for gall-stones, and vice versa.

Calculus in the ureter is to be diagnosed if the patient gives a history of renal stone culminating in an attack of renal colic and followed by pain low down in the iliac fossa or groin, with or without hydronephrosis, and a skiagram shows a shadow in the line of the ureter. (Plate XIX., Fig. 2.) Pyelography, or the passage of an opaque bougie, will demonstrate the relation to the ureter of a doubtful shadow. Cystoscopic examination may reveal a stone actually protruding from the ureter, but more commonly assists the diagnosis by showing the presence of ureteritis, the orifice of the affected ureter being either congested and prolapsed or, in later stages, retracted and patulous. In some cases all previous history is absent, and the complaint of low abdominal pain may suggest disease of the appendix if right-sided, or of the uterine appendages in the female. In rare cases the stone has been felt in the ureter per vaginam.

Pyelitis occurs in two main forms—primary, i.e. in the absence of other disease of the urinary tract; and secondary, following upon disease of the kidney such as calculus or tumour, or infective conditions of the bladder.

Primary pyelitis is to be diagnosed if a patient complains of slight chronic or recurring pain in the loin, accompained by moderate frequency, and organisms (usually *B. coli communis*) in large quantities, with or without pus, are found in an acid urine. Examination by the usual means reveals nothing else abnormal, but a pyelograph may show the renal pelvis slightly enlarged with an *irregular outline*.

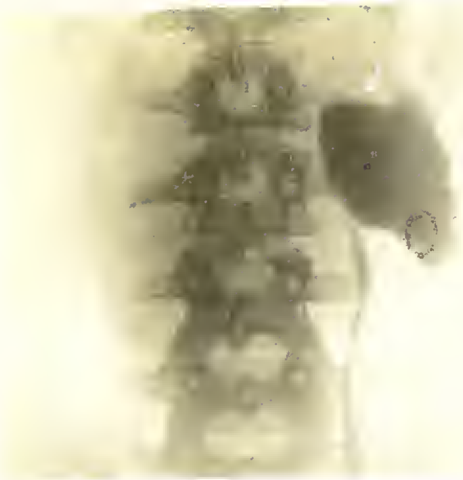


Fig. 1.—Pyelogram: Hydronephrosis (p. 696).

The three lower arrows point to the ureter; the outer one to the dilated kidney, the one above to the dilated pelvis.

(*Thomson-Walker's "Genito-Urinary Surgery."*)

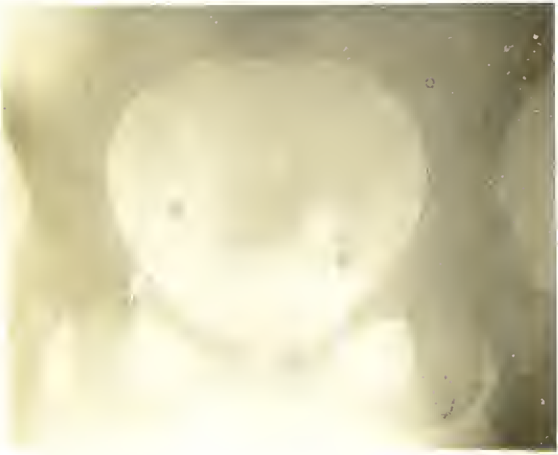


Fig. 2.—Calculi in ureters (p. 700).

PLATE XIX.

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Pregnant women are especially liable to *B. coli* pyelitis, which in them produces acute symptoms, the frequency being accompanied by severe pain, fever, and vomiting. It is also met with in those suffering from chronic constipation, colitis, or cæcal stasis, but the symptoms in these cases are of a chronic rather than an acute type.

Secondary pyelitis is to be suspected where there is much pus in the urine in cases of renal calculus or tumour, or in cystitis when the pain is referred also to the loins, and the patient's condition is unusually grave.

Pyelonephritis, or suppurative pyelonephritis, is always secondary to cystitis; it may follow operations on the bladder or urethra when infection is present or introduced at the operation; it is to be diagnosed in such a case if the patient becomes gravely ill, with intermittent high fever, rigors, vomiting, and prostration. There is pain in both loins, and pus in large quantities in scanty urine. In the worst cases there is complete suppression.

Tuberculous nephritis is diagnosed with some difficulty in its early stages. The patient complains of slight intermittent pain in the loin, and of gradually increasing frequency of micturition. The urine may show pus-cells microscopically and a few red blood-cells from time to time, and careful bacteriological examination of segregated urine proves the presence of the *B. tuberculosis*. In the early stage the kidney is not tender, and the cystoscope reveals nothing abnormal. A pyelograph will at the most only show the picture of pyelitis. The early diagnosis rests upon finding the specific bacillus in segregated specimens of the urine. As the disease progresses the symptoms become more marked. Pain is more pronounced, and the urine contains more pus and blood. Extension of the infection to the bladder is evidenced by great frequency, etc. The cystoscope will then afford unmistakable signs of the disease. Apart from evidence of tuberculous disease in the bladder itself, chronic ureteritis is detected by alterations in the ureteric orifice on the affected side. In advanced and typical cases the orifice assumes the so-called "golf-hole" or punched-out appearance. The pyelograph picture may show ulceration of the kidney substance, the opaque solution making its way from the calyces into the cortex of the kidney. Tubercle bacilli are found in increasing numbers. With progressive disease and impairment of function of one kidney, compensating hypertrophy of the other takes place. Such an enlarged kidney may be easily palpable, and the seat of pain and tenderness. The affected kidney may be tender, but is not, as a rule, unduly palpable unless extension into the perirenal tissue, with the formation of a perinephritic abscess, takes place.

Tumours of the kidney :

1. Congenital cystic kidney.
2. Papilloma of the renal pelvis.
3. Sarcoma of the renal pelvis.
4. Hypernephroma.
5. Movable kidney.

1. **Congenital cystic kidney** is to be diagnosed if a patient under 40 years of age gives a history of polyuria, headache, wasting, and indigestion, and a tumour is found in one or both loins. The disease is bilateral, but the kidney of one side may be much larger than the other or become palpable some time before its fellow. The urine in such cases is large in amount until near the end, when it becomes scanty, of low specific gravity, and contains a much diminished total output of urea. Albumin is, as a

rule, present. The tumours are firm, not tender, with an irregular surface, and enlarge steadily. Cystoscopy affords no evidence of disease, but the pyelogram is typical, the calyces being stumpy with club-shaped extremities

2. **Papilloma of the renal pelvis** is to be diagnosed if there is recurring hæmaturia shown by the cystoscope to come from one kidney and the urine from that side contains much pelvic epithelium or portions of the growth. Implantation of the growth may take place at the base of the bladder and confirm the diagnosis. There is no appreciable enlargement of the kidney. There may be renal colic due to the passage of blood-clots down the ureter. In the absence of portions of growth in the urine the diagnosis is uncertain, the other conditions to be excluded being varix of the renal papillæ, calculus, and tuberculous disease. The association of calculus with symptoms pointing to growth strongly suggests that the growth in the pelvis is malignant in character.

3. **Sarcoma of the kidney** is to be diagnosed if a child is found to have a rapidly growing solid renal tumour. The tumour may attain a great size. In some cases early, in others not till a late stage, there is hæmaturia. The general condition of the patient is rapidly affected, wasting becoming extreme.

4. **Hypernephroma.** — About 80 per cent. of solid renal tumours in adults are of this variety. In the absence of a palpable enlargement of the kidney the diagnosis is suggested by a history of recurrent renal hæmaturia without pain. No evidence of tuberculous disease or calculus is obtainable, and the pyelogram shows distortion of the normal pelvis and calyces. The former is attenuated towards one or other pole and the calyces are elongated and com-

pressed, the whole appearance being described as "spider-like." When a palpable tumour is present the diagnosis is of course simplified.

5. **Movable kidney** is included under renal tumours because such a kidney forms a palpable abdominal lump. It is to be diagnosed if a patient—usually an ill-nourished female—complains of dragging pain in one loin when in the upright posture, relieved by lying down. In some cases there is also a history of attacks of acute pain lasting some hours, followed either by the passage of a large quantity of urine (intermittent hydronephrosis), or by hæmaturia (Dietl's crisis). These patients are, as a rule, subject to other troubles, such as headache and dyspepsia. On examination the kidney, almost invariably the right, is easily palpable, or becomes so on inspiration. A movable kidney can always be replaced into the loin by the surgeon's hand; it is tender, and *feels* larger than a normal kidney. The degree of mobility is gauged either by the range of movement during inspiration or by an examination in the upright as well as in the recumbent position. Pyelograms which are taken in both positions give the same information, and also demonstrate any hydronephrosis or kinking of the ureter which may be produced. (Plate XIX., Fig. 1, facing p. 700.)

Urethral fever.—When, soon after the passage of a catheter, the operation of lithotrity, or some similar local irritation, the patient is seized with a rigor, followed by great heat of skin, and then by a profuse sweat, the temperature rising considerably during the rigor and falling to the normal during the sweat, and the whole illness passes off in a few hours, the illness is *acute urethral fever.* The attack may vary much in intensity; it resembles a paroxysm of ague or a pyæmic rigor, but is characterized by its transient character and its connexion with urethral irritation. When the attack is repeated at the interval of a few hours or days, it is called *recurrent urethral fever*. The effects of infection from a catheter or following an operation, viz. *cystitis*, *pyelitis*, and *pyelonephritis*, have been considered under their respective headings earlier in the present chapter.

CHAPTER XLIX

DIAGNOSIS OF DISEASES OF THE HAND

Deformities.—The hand is frequently the seat of congenital or of acquired deformities.

The common **congenital deformities**, which are all easily recognized, are *supernumerary digits*, *absence of digits*, *webbed-fingers* or *syndactyly*, *gigantism* of one finger or *macrodactyly*, and *congenital contraction* of the finger. In this latter deformity the finger is found hyperextended at the first phalanx and flexed at the second and third, thus differing from Dupuytren's contraction (*see* p. 707). Various types of *club-hand* also occur, in which the hand is deflected to one or other side or is hyperextended or flexed, due to abnormal development of the radius or ulna. In "congenital amputation" of the forearm the hand is represented by a shapeless mass bearing upon its extremity one or more knobs as rudiments of digits.

The common **acquired deformities** are *spring-* or *snap-finger*, a condition in which, when the patient attempts to open his hand, one finger remains flexed, and on extending it with the other hand it opens with a jerk. *Mallet-finger* is one in which the terminal phalanx is maintained in a state of flexion owing to damage to the extensor aponeurosis. *Clubbing* of the fingers, i.e. thickening of the terminal phalanges, occurs in chronic pleura and lung disease such as chronic empyema, bronchiectasis, or phthisis, Contraction of one or more fingers may follow suppuration in the flexor tendon-sheaths. Another deformity, coming on especially in men of middle or later life, is that characterized by flexion of the fingers at the metacarpo-phalangeal and first interphalangeal joint; on attempting to straighten the digit great resistance is met with in the palm, and the palmar fascia is felt to be tense and firmly adherent to the skin, which is marked with transverse creases; this is known as *Dupuytren's contraction.* The deformity begins and is most marked in the little finger, then the ring finger. It is frequently bilateral.

Permanent paralysis of the ulnar nerve results in a "claw-hand," i.e. hyperextension at the metacarpo-phalangeal, and flexion at the interphalangeal joints, together with wasting of the interossei, most noticeably in the first interosseous space. "Congealed hand" is the name sometimes given to the cramped atrophic hand which follows median-nerve paralysis, and also, sometimes, severe gunshot wounds of the upper limb without main nerve-trunk lesions.

The hand is sometimes greatly distorted by the contracting scars of a *burn.* To be distinguished from this is a spontaneous disease of the skin lasting many years, which gradually draws the fingers together and finally converts the hand into an irregular club-shaped mass, from which the ends of the fingers project; the part, which is covered by a reddish cicatricial skin, is ulcerated or covered with thick yellow crusts; this disease is a form of *lupus.*

The appearance of the hand is also affected in certain remote diseases. In this connexion must be mentioned the "spade-like" hand of acromegalics, and the flat, wasted hand seen in cases of progressive muscular atrophy, syringo-myelia, and cervical rib.

Acute inflammation may attack any of the structures of the hand, and is characterized by its usual signs; but the surgeon must endeavour to determine its exact seat. If the pain and swelling are in the **wrist**, the joint should be very gently moved, and then, while the wrist-joint is fixed by grasping it in the hand, the fingers should be carefully flexed and extended; should it be found that every movement of the wrist-joint is very painful, but that when it is held fixed the fingers can be moved without causing pain, it will show that there is *acute inflammation of the wrist-joint.* If, however, movement of the fingers is found to be painful when the wrist-joint is fixed, it points to *acute teno-synovitis*, and if soft grating or friction is felt during the movement this diagnosis becomes certain. In some cases of joint disease the sheaths of the tendons become involved. In teno-synovitis the pain is more exactly localized than in arthritis, and no pain is caused by gentle vertical pressure of the hand against the forearm. The actual tendon affected will be ascertained by the position of the pain and swelling, and by noticing what movement it is that causes the acute pain.

The palm.—When a swelling extends up under the anterior annular ligament to the lower part of the forearm, it indicates affection of the common palmar synovial sheath. It is impossible to detect fluctuation from small collections of pus through the tense and œdematous palmar fascia, and the surgeon must rely for the diagnosis of suppuration upon other signs; of these the best are œdema of the back of the hand, throbbing pain, increased swelling, and pyrexia. Abscess is often met with at the clefts of the fingers.

The digits.—Acute inflammation of the digits is usually called *whitlow* or *paronychia*, as it is much the most frequent in the last joint. Four forms are to be recognized: Where there is a sharp, stinging, smarting pain, moderate swelling, and the quick formation of a flat bleb containing milky pus, it is the most superficial form, a simple *dermatitis* or *subcuticular whitlow*. On removing the raised cuticle the derma is seen bright red and glazed; if the disease spreads to the nail, that structure is shed. If the end of the finger is greatly swollen, with severe aching and throbbing pain, the inflammation is deeper; if, when the swelling is opened or bursts, a slough of cellular tissue escapes and the sore heals up, the probe not detecting any bare bone, it is *subcutaneous whitlow;* but if. when the swelling bursts or is opened, the probe detects bare bone, and the sinus remains open until a sequestrum is removed, it is *periosteal paronychia.* When a finger or thumb is greatly swollen along its whole length, particularly on the palmar aspect, which is very painful and tender, and any movement of the digit causes acute pain, it may be diagnosed as acute inflammation of the sheath of the flexor tendons, or *paronychia tendinosa.* When occurring in the thumb or little finger it may spread to the common palmar sheath.

When a patient is the subject of subacute *painless* suppuration in the fingers or hand, with much swelling of the soft tissues, and sloughing, or necrosis, examine the sensitiveness of the limb to heat, cold, touch, and pain. Such a condition is very liable to occur in *syringo-myelia* of the cervical enlargement, or after injuries of the ulnar or median nerve.

Chronic disease.—A chronic inflammatory enlargement of a phalanx is known as *dactylitis.* If the swelling is smooth and uniform, affecting the entire bone, fusiform in shape, and not showing any tendency to suppurate, it is probably *syphilitic*, and other signs of this disease must be sought to support the diagnosis. If the swelling is less regular, affecting alone or chiefly one part of the bone, and shows a tendency to soften or to ulcerate, it is *tuberculous ;* this disease may lead to great shortening of the finger. An exactly similar disease is met with in the metacarpus. (Plate xx., Fig. 1.)

A chronic painless superficial ulcer on the finger with infiltration beneath, and moderate firm enlargement of the axillary and epitrochlear glands, is a *hard chancre.* Confirmation of this diagnosis is afforded by finding the spironema in the discharge and a positive Wassermann reaction.

An ulcerated warty excrescence on the dorsum of the hand, chronic in its course, and accompanied by enlargement of the epitrochlear and, perhaps, axillary glands, and by small subcutaneous nodules up the arm in the course of the main lymphatics, is a *butcher's wart*—a tuberculous lesion due to local infection with the tubercle bacillus. It is met with in those who handle carcasses or take part in post-mortem examinations.

Epithelioma is not infrequently met with on the dorsum of the hand in persons of 65 years and over. It presents the usual features of this disease, but involvement of glands occurs only after a long interval, if at all.

Tuberculous disease of the wrist causes swelling around the bones, pain on movement and on pressure through the bones, and later on grating, abscess, and sinuses leading down to carious bone. A skiagram shows erosion of articular surfaces and loss of opacity of the affected bones. In late stages there may be considerable destruction of bone.

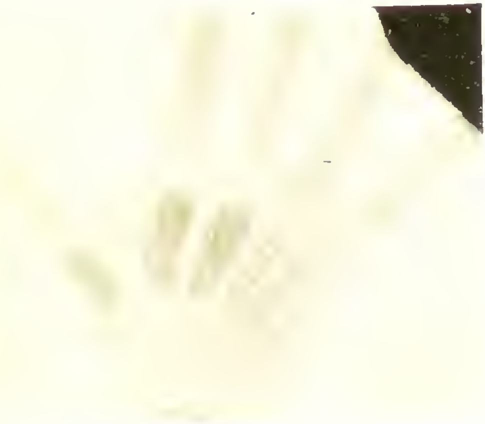

Fig. 1. Tuberculous dactylitis (p. 710).

(*Knox's "Radiography and Radio-Therapeutics.*)

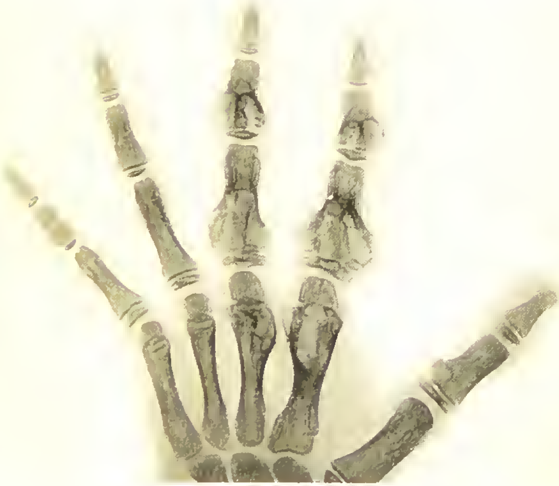

Fig. 2.—Multiple enchondromata (p. 712).

PLATE XX.

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Effusion into the palmar sheath or *compound ganglion* causes swelling on the front of the wrist extending into the palm and a short distance up the forearm; fluctuation can be obtained between the upper and lower parts of this swelling, and often fremitus from the "melon-seed bodies" in the effusion. It is usually a tuberculous affection. It is distinguished from disease in the wrist-joint by the absence of tenderness on pressure through the bones, the less rigidity and pain, the absence of swelling over the dorsum of the wrist, and the integrity of the bones as seen in a skiagram.

A tense ovoid or globular fluctuating swelling on the back of the hand or front of the wrist is a *circumscribed ganglion*; this may be connected with one of the tendon sheaths, or with an articular synovial membrane.

Occasionally soft grating is felt in a tendinous sheath due to chronic dry *teno-synovitis*; but more often there is effusion, and a fluctuating swelling having the shape and position of the sheath is found; when the fluid contains "melon-seed bodies" the movement of the fluid imparts a peculiar thrill-like sensation which is characteristic.

If one or more of the bones of the hand undergo a steady painless enlargement, forming an ovoid or globular swelling, at first firm and unyielding, but later on giving "egg-shell crackling" or becoming slightly elastic, and not yielding to treatment, the disease will be recognized as *enchondroma*. The tumour occurs in early life, grows more often from the interior than from the surface of these bones, and is often multiple. When it appears as a pedunculated outgrowth from the surface of the bone at the junction of epiphysis and diaphysis, it quickly ossifies. A commencing enchondroma cannot be distinguished from periostitis; but the absence of injury as an exciting cause, of pain or tenderness, of other evidence of syphilis or tubercle, and a skiagram, will clear up the case; "egg-shell crackling" at once establishes the diagnosis of tumour. (Plate xx., Fig. 2.)

When the joints of the fingers become semiflexed, adducted, stiff and painful, with creaking and grating in the joints, and nodular thickening around, the disease is *arthritis deformans* or *osteo-arthritis*.

The **nails** may be found very brittle or irregular, with nodular thickening near the free edge; both conditions are the result of *syphilis*; occasionally, from syphilis, the nail is partially or wholly separated from the matrix, and slowly shed. If the end of the finger is bulbous and reddened, the nail discoloured and out of shape, and beneath it is seen a foul ulcer of the matrix with dark discharge, it is *onychia maligna*. Inquiry should be made for evidence of *syphilis* and *tubercle*; the disease is often started by injury.

CHAPTER L

DIAGNOSIS OF DISEASES OF THE FOOT

Deformities.—When the ankle-joint is extended and the heel is raised from the ground in standing, the deformity is known as *talipes equinus*. This deformity varies much in degree, and the patient may walk on the ball of the toes or on the dorsum of the foot. The position of corns and callosities is a useful indication of the part of the foot upon which the patient walks. When the ankle is flexed, and the patient rests solely on the heel with the toes raised from the ground, it is *talipes calcaneus*. When the foot is rotated in at the transverse tarsal joint so that its inner border is raised and shortened, and is marked by a deep groove under the head of the astragalus, while the outer border is depressed and a corn or callosity is developed over the cuboid bone, it is *talipes varus*. If the foot is rotated out so that its outer border is raised from the ground and the peroneal tendons are tense while the inner border is depressed, it is *talipes valgus*. If the arch of the foot is abnormally deep, the patient resting merely upon the heel and the ball of the toes, it is *talipes cavus*; while when the arch of the foot is lost, so that in standing the whole length of the inner border of the foot rests upon the ground, the head of the astragalus and the tubercle of the scaphoid being unduly prominent, it is *talipes planus*, "flat-foot," or "spurious valgus." Two or more forms of talipes may be combined; thus, talipes equinus and varus are frequently associated, and talipes cavus may be superadded; talipes valgus and calcaneus are often found together, and in extreme cases of talipes planus some amount of valgus may be found.

Talipes is either **congenital** or **acquired.** The *congenital* cases are recognizable by their history, and in some cases by associated deformities such as spina bifida, and, where not due to paralysis, by the well-nourished condition of the limb and the great resistance to correction of the deformity.

Cases of *acquired* talipes must be carefully investigated with a view to tracing the deformity to the contraction of cicatrices or injuries dividing nerves (*traumatic*); to retention of the foot for a long period in one position (*static*); to paralysis of muscles (*paralytic*); or to spasm of muscles (*spastic*): in the last case some source of *reflex* irritation or evidence of *neuromimesis*, such as intermission of the deformity, must be sought. When the leg is cold, perhaps even livid, and the muscles are wasted, and the patient is unable to move the foot and toes in the usual directions, the talipes is certainly *paralytic*. Occurring as it usually does in children, the disease interferes with the growth of the limb, which is more or less shortened, and the skin may be dry and rough. The surgeon must notice how far, and with how much force, he can correct the deformity, and what tendons or bands of fascia are then made tense.

The great toe is often found pushed out of the straight line under or over the outer toes (*hallux valgus*), and then a bursa is apt to develop over the head of the metatarsal bone—this is known as a *bunion*; the bursa may become inflamed and suppurate. Loss of free flexion in the first metatarsophalangeal joint produces what is known as *hallux* *rigidus;* this is often associated with *talipes planus.* If a toe is bent back at the metatarso-phalangeal joint, and flexed at the two terminal joints, the deformity is known as *hammer-toe;* this affects especially the second toe and is often complicated with a corn over the dorsum of the first interphalangeal joint and another over the tip of the toe.

The **skin of the sole** is often the seat of *corns* or *callosities* over the points of greatest pressure. *Syphilis* may give rise to thickening of the skin of the sole, with marked fissuring; this condition must be distinguished from psoriasis. Irregular *fissures* and *ulcers* may be found between the toes in syphilitic patients, called *rhagades digitorum.* An ulcer may be found at either side of the nail of the great toe—most commonly the outer side—into which the edge of the nail presses; this is a cause of great pain, and is attended with discharge and the growth of a fleshy mass over the nail; it is known as *ingrowing toe-nail.* Ulcers are sometimes met with in the sole of the foot in the centre of corns; they are painless, very chronic in their course, and a probe is found to pass in deeply between the metatarsal bones, or to strike bare bone; they are known as *perforating ulcers.* The surgeon should examine the sensibility of the surrounding skin and the condition of the tendon reflexes, the gait, the pupil, and the spine, and should inquire for lightning-like pains in the legs; these ulcers are often found in connexion with local anæsthesia, or tabes dorsalis, or spina bifida occulta. Sinuses are also met with in connexion with diseases of the bones and joints.

Tumours.—*Circumscribed ganglion* may occur on the dorsum of the foot as on the hand. A firm tumour rising up under and displacing the nail of the great toe is a *subungual exostosis.*

The **bones and joints** of the foot can easily be individually examined, and any swelling or tenderness to pressure or movement can be readily determined, while the probe passed into sinuses may detect either necrosed or carious bone. By pressing each toe separately back towards the heel, evidence of inflammation of the bases of the metatarsal and anterior tarsal bones can be obtained. A good skiagram is of great value in the diagnosis by showing the integrity or otherwise of individual bones.

Tuberculous disease of a tarsal bone is very prone to spread to one of its joint surfaces, and, from the large size and complexity of the synovial membranes, to extend quickly thence to several bones. This is especially true of the astragalus and scaphoid bones. The position of swelling and tenderness, and the movements which cause pain, as well as the position of sinuses, are the signs, in addition to the evidence afforded by the skiagram, by which the locality of tuberculous disease of the bones of the foot is determined.

Extensive tuberculous disease may occur in the os calcis without involvement of either of the other bones.

Gout attacks the metatarso-phalangeal joint of the great toe with much frequency. If the great toe is chronically displaced outwards, and the usual prominence of the head of the metatarsal bone is much swollen, very painful, tender, reddened, and fluctuating, there is a *suppurating bunion.* The abscess may burst and leave a sinus, or may spread into the joint; this will be shown by the occurrence of grating and of great pain on moving the phalanx on the metatarsus. The acute inflammation of the bunion will be distinguished from gout by the history of the case and by the absence of the premonitory signs of gout.

When a patient complains of great pain on standing or walking, felt in the sole under the head of the third or fourth metatarsal bone and shooting down along the toes, and on examining the part no acute or grave change is found, but pressure on one particular spot causes the same severe pain, the affection is *Morton's disease,* and the pain is caused by pressure of the bone upon a digital nerve. Less severe pain, not shooting down to the toes, and not associated with such acute local tenderness, is caused by undue thinness of the soft tissues of the sole.

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